February 2, 1911.

PUBLIC LIBRARY
FEB 4 19
THE

American Machinist

A Practical Journal of Machine Construction

Issued Weekly by the Hill Publishing Company : : : 505 Pearl Street, New York

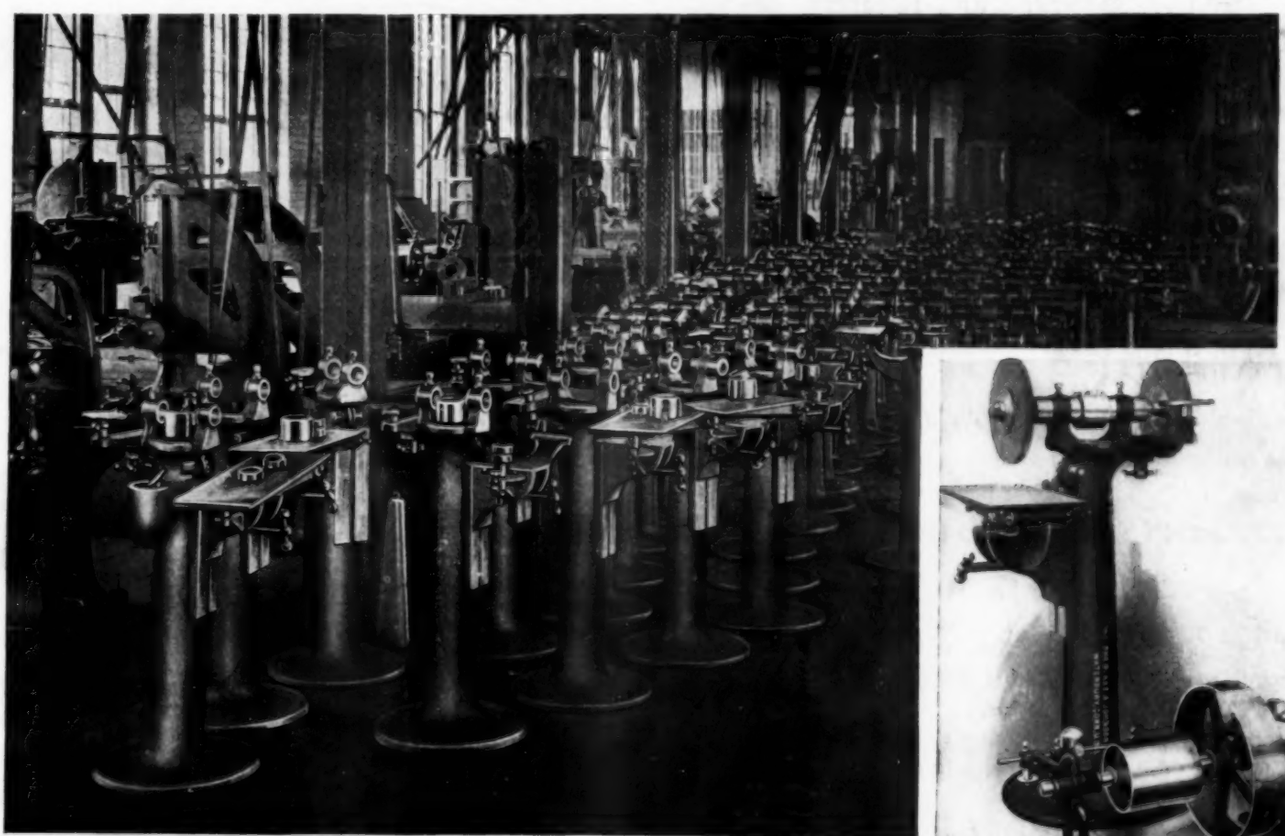
Price 15 Cents, $4.00 per Year

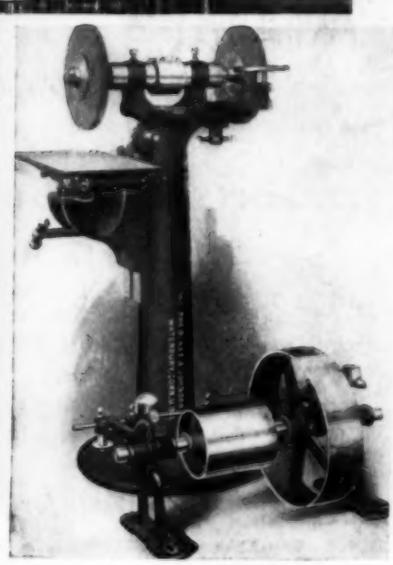
Contents 223. Advertising Index 69

The Waterbury Grinder

With Wheels **$50** **With Counter**

For Tool Rooms—Dies—Punches—Surface Grinding





7,000 Parts Machined Uninterruptedly
Enable Us to Sell Accurate Machines at a LOW PRICE

13 cents per pound ready to run, and will be sent on approval.

$55 boxed for sea shipment f. a. s. for New York or Boston.

The Blake & Johnson Co.,

Machinery Division **Since 1849** **Waterbury, Conn., U. S. A.**

Consider the Time and Labor Gained

by simultaneously drilling several holes in long, heavy work or in a number of similar castings

CONSIDER the time and labor lost by drilling each hole individually. If the work is very heavy, crane manipulation is necessary to reset the piece for each hole—or, if no crane is available, several men are necessary to shift the piece for the next hole.

If the work is very long, supports must be provided on either side of the drilling table to support the work. If the work is irregular, it will require fastening and releasing for each hole.

If great accuracy is required, more time will be lost in chipping and shifting to make the drill take the center of the outlined hole.

70 Niles 3-spindle Drill with Traveling Table

By Installing A

Niles Multi-Spindle Drill

from 2 to 8 spindles

remarkable savings can be effected in expediting the drilling of heavy work.

Each drill-head has independent adjustments and independent drive and feed clutches. They can also be provided with transverse adjustment for staggered drilling.

Table can be furnished with plain or compound movement, and with power or hand elevating gear. Also special tables or supporting devices to suit individual requirements.

Drive is very powerful, and construction is very rigid, permitting accurate drilling at heavy feeds and high speeds that is limited only by the endurance of the drills.

As each head can be rigidly clamped in position, perfect alignment, exact intervals and accurate duplication are always maintained.

Write for photos and particulars of any type or size interested in.

Niles-Bement-Pond Company

111 Broadway, New York. 23-25 Victoria St., London, S. W.

SALES OFFICES—Boston: Oliver Bldg. **Philadelphia:** 21st and Callowhill Sts. **Pittsburgh:** Frick Bldg. **Cleveland:** Rockefeller Bldg. **Hamilton, O.:** The Niles Tool Works Co. **Detroit:** Majestic Bldg. **Chicago:** Commercial National Bank Bldg. **St. Louis:** 516 No. Third St. **Birmingham, Ala.:** Brown-Marx Bldg. **Agents for California, Nevada and Arizona:** Harron, Rickard & McCone, San Francisco and Los Angeles. **Washington and Idaho:** Hallidie Machinery Co., Seattle and Spokane. **Oregon:** Portland Machinery Co., Portland. **Agents for Canada:** The Canadian Fairbanks Co., Ltd., Montreal, Toronto and Vancouver. **Japan:** F. W. Horne, 70-C Yokohama. **Italy:** Ing. Ercole Vaghi, Milan. **Germany:** F. G. Kretschmer & Co., Frankfort a.M.

(*See pages* 61 62, 63 and 64)

New Features in Boring Machines

The latest design of horizontal boring machine built by the Lucas Machine Tool Company, Cleveland, Ohio, and known as their No. 32, contains many features of special interest to all machine designers and users. It is shown in Fig. 1 and while there is nothing startlingly novel in the general appearance of the machine, the solution of the problems of speed and feed changes, as well as their convenient and logical distribution, will be appreciated by all.

There may be said to be two general methods of machine design; one to concentrate everything in a given point—the other to distribute the mechanisms so that each may be made separately and occupy more space. In either method, the modern designer recognizes the advantages of bringing the controlling levers to a central point.

Mr. Lucas' experience has led him to choose the separate or unit method and the way in which the various points have been worked out, is extremely interesting.

Editorial Correspondence

An interesting example in boring-machine development, by the use of separate power and feed units which are brought to a central distributing point without excessive gearing and with a simple interlocking mechanism which prevents accidental engaging of any two feeds at once.

Its transformation to a vertical and horizontal milling machine of wide range by adding a substantial cross rail with a vertical or horizontal spindle, using the same power and feeding mechanism as before.

The Speed Box

Beginning with the single-drive pulley, which runs on an extension of the speed box and has no overhang, the power is transmitted through the easily adjustable clutch on the outer end, to the main shaft of the speed box, as shown in Fig. 2. This view shows the large size of the gears used, which insures long life and a freedom from the troubles which many gear boxes are heir to. The gears on shafts *A* and *B* slide into three positions; those on the intermediate shaft being fixed. This gives nine changes. These are doubled by back-gears in the head, giving a range from 7½ to 150 revolutions per minute of the spindle.

The Spindle Construction

The spindle is of forged steel, and has a large tapered front bearing as in modern milling-machine construction. This runs in a solid bronze bushing in the solid head of the machine with a collar between the shoulder on the end of the spindle and the end of the bronze bushing. This makes a very solid construction and a very slight reduction in the thickness of this collar allows for any adjustment that may be necessary after long use. The rear bearing is straight but the split bushing is tapered on the outside and can be adjusted by the locking nuts shown to compensate for all wear.

The spindle is driven by the bevel gears *C* shown in Fig. 2, through the vertical shaft to a back gear in the head, doubling the changes obtained in the speed box.

The feed gears are driven by the spur gear *D* shown beside the bevel gear. This makes the feed dependent at all times on the spindle speed, so that it is always a "certain amount per revolution of the spindle" instead of "inches per minute" as would be the case if the feed were taken from the first shaft.

The speed changes are secured by the two levers, *A* and *B*, Fig. 1, each having three positions, and the back-gear lever *C*, which also controls a sliding, two-speed gear. The speed box is entirely closed, the sliding plates under the levers preventing the entrance of dirt and foreign matter at all times.

Running from the inner end of the main driving shaft to the sprocket *S* in

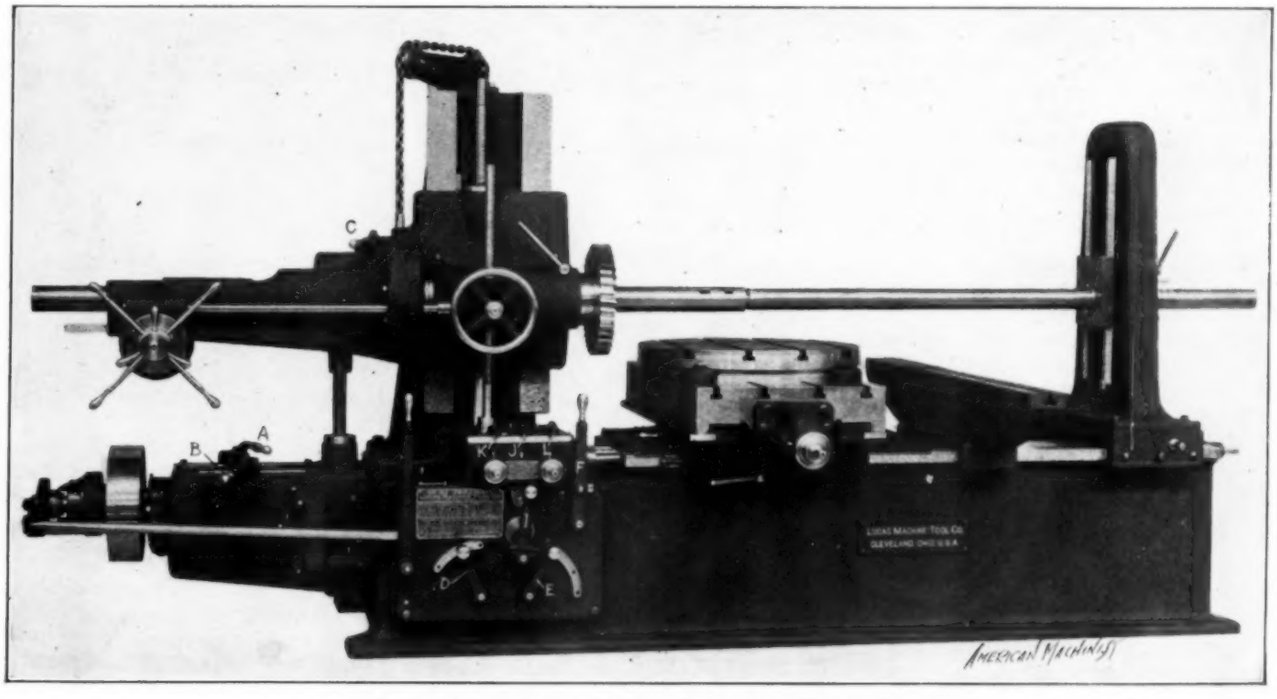


Fig. 1. The No. 32 Lucas Precision Boring Machine

Fig. 3, is a flexible chain which handles all power movements of the machine. Coming from the first shaft of the speed box, this has a constant speed so that all power movements are at maximum speed, and entirely independent of the varying speeds of either the spindle or the feed.

The Feed Box

All the feed changes are secured in the box shown in Fig. 3. The gear *D*

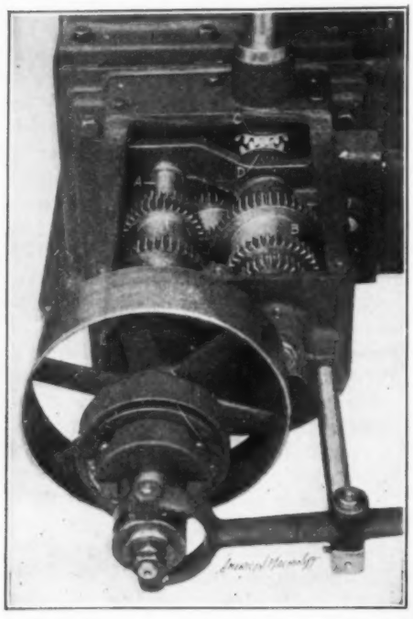


Fig. 2. The Speed Box

shown in Fig. 2 drives gear *A* in Fig. 3, and the sliding gears on this shaft, also of ample size, give 9 feed changes for each position of the spindle-driving gear, or 18 in all, varying from 0.004 to 0.600 inch per revolution. These are transmitted through the fixed gears on the lower shaft, to gear *B*, which is then ready to drive the feed for the head, the spindle, the table or the platen, as may be selected, but no two of them can be thrown in at once.

Having selected the right feed by means of the feed levers *D* and *E*, Fig. 1, the feed can be thrown in, or instantly thrown out, by the clutch lever *F*. This lever also controls the power movement of any of the parts and through the main elements of the same mechanism as we shall see later. The shaft carrying the clutch collar runs through a sleeve inside the sprocket wheel and is fastened to the male portion of the cone clutch *G*. This runs free when the feed clutch is thrown in, but when the feed lever is thrown in the opposite direction, the clutch collar acts against the ball-thrust bearing *H* and pulls the cone clutch into place.

The Power Traverse

This engages the power traverse for whatever movement was selected for feeding, *the power traverse always being in the opposite direction to the feed,* and at a constant rate.

Should a man become confused and throw in the power traverse by mistake, it moves the cutter or boring bar away from the work instead of into it, and should he throw the lever too far in releasing the feed suddenly, the same safeguard is provided. As the power traverse is only operative while the clutch is held into place by the hand, this provides a safeguard against damage, should the part being operated be accidentally moved to the end of the travel, the clutch slipping if an undue load be thrown on it.

All feeds are secured by the single gear train and are reversed by the double clutch *K*, and the bevel gears shown in the center of the box. This clutch is controlled by the reversing lever *I*, Fig. 1, which is of novel construction. Reversing the direction of the feed does not affect the power movement, which remains in an opposite direction to the feed in all cases.

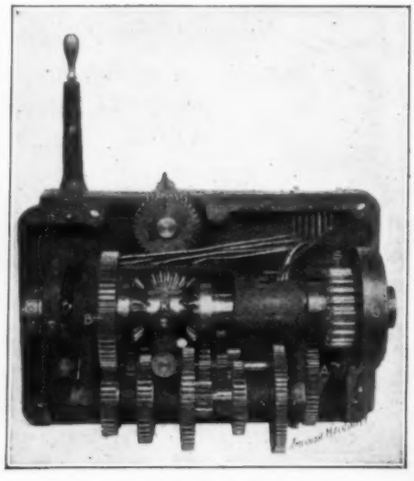


Fig. 3. The Feed Box

The reversing lever proper is not fastened to the reversing shaft, but turns on it, behind the segment shown on the end of this shaft. Between the segment and the reversing lever is a stiff, flat spring, which forms the only connection between the lever and the shaft.

If, as often happens, the clutch teeth are not in position to engage, the reversing lever can be thrown just the same and locked in position. As soon as the clutch has moved enough to allow engagement, the spring forces them in place, saving all manipulation of belts by hand or feeling for the position by the power traverse.

The Distributing Box

One of the most novel and attractive features of the machine, from the designers' point of view, is the distributing box shown in Fig. 4. All the feeds come from the feed box through a spur gear behind the central bevel in Fig. 3, and up through the spur gear shown, to the central gear *J* of the distributing box. In this way both the constant power movement and the nine changes of feeds are transmitted to the distributing box, to be directed by the operator in any way he desires.

The three parallel shafts shown, distribute all the feeds in both directions, and also the power traverse to all parts. Shaft *K* controls the vertical movement of the head and the outer support through the rear bevels and the spindle traverse by means of the front bevel driving the shaft shown behind the handwheel. In the illustration the vertical bevel is lifted out of place with the distributing box cover which is raised to show the mechanism.

The gear on *K* has a clutch on both ends, while *J* and *L* only clutch in one direction. Shaft *J* controls the platen and *L* the saddle.

These clutches are controlled by the small handles shown on the cover, these being ingeniously arranged to prevent more than one being thrown in at once, preventing injury to both work and workmen. They are made interlocking by the ingenious method shown in Fig. 5.

In addition to this, the handle on *K* is arranged to prevent being thrown from one position to the other without deliberate intent on the part of the operator. This

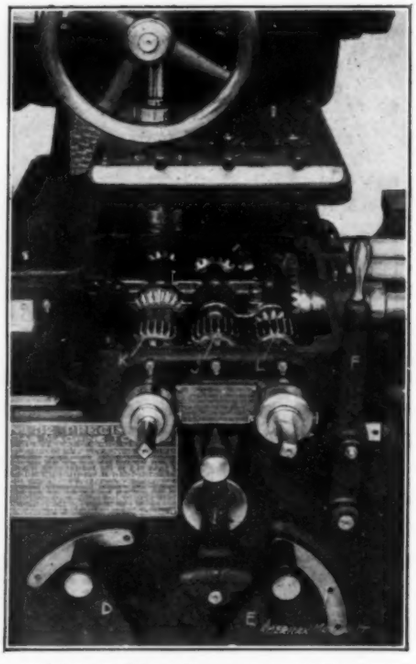


Fig. 4. The Distributing Box

is done by means of a small sliding bar which can be easily thrown at will, but which prevents accidental engagement of the wrong feed.

Feed-locking Device

Fig. 5 shows the simple and very ingenious locking device, which prevents more than one feed being thrown in at

the same time. As before mentioned, lever *K* controls the spindle and the head feed, *J* the platen and *L* the saddle movement. The clutch-throwing fingers *G* are mounted on a round base *H*, in the cover of the distributing box and held in position by a steel ball held by a spring and

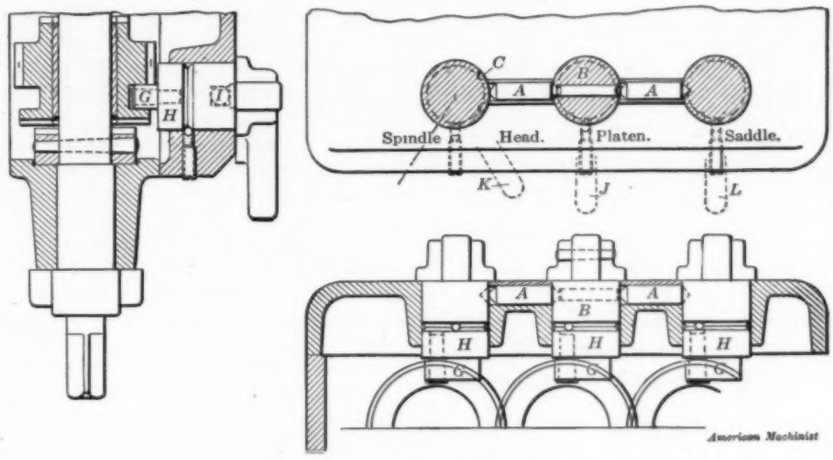


FIG. 5. INTERLOCKING THE FEED LEVER

set screw from the front of the cover acting in the groove shown.

The central body has a hole through it carrying the round-ended pin *B*, while the cone-pointed pieces *A A* lie in a milled slot, as can be seen at *I*. In the position shown, handle *K* is thrown so as to move the head, and it will readily be seen that neither the platen nor the saddle feed can be thrown in, as both *J* and *L* are locked by the cone points of *A A*.

Throwing *K* back to its central position allows the conical end of A to be moved into the depression *C*, so that either *J* or *L* may be moved, but not both. A slight depression in the groove on the body *H* allows the spring-pressed ball to hold the levers in position to overcome any tendency to move from any vibration of a shop floor.

SECTIONAL CHIP GUARDS

It will also be noted in both Figs. 1 and 6 that the ways of the bed are protected against chips by a series of light covers, which have jig-drilled connections so as to be readily interchangeable. These covers are made in 6-, 9- and 12-inch widths and can be used in any combination desired, being transferred from one side of the table to the other, according to its position. In addition to protecting the ways these also form very convenient trays for tools and wrenches.

The boring bar is 3½ inches in diameter, and has a No. 5 Morse taper. It has a total traverse of 48 inches. The greatest distance between the face plate and the outer support for the boring bar is 6 feet in the regular machine, but 7- and 8-foot beds are made to order. The greatest distance from the top of the platen to center of boring bar is 24 inches in the regular machine, but can be increased to 30 inches when desired. The platen is 24x48 or 56 inches, as desired. The cross feed is 36 and 44 inches and has an automatic trip.

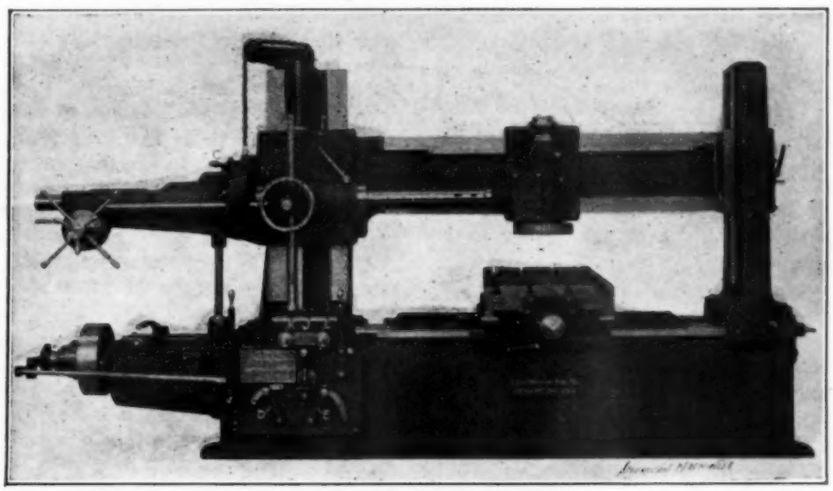


FIG. 6. EQUIPPED FOR A WIDE RANGE OF SURFACE MILLING

AS A MILLING MACHINE

The latest development of this machine is in the form shown in Fig. 6, where a substantial beam or cross rail is doweled and bolted to the head and the outer support and in the case shown, carries a heavy vertical milling spindle. This spindle is constructed along the same lines as the main boring spindle, as shown in Fig. 7, and milling cutters can be held by either a draw-in bolt, or in the case of large diameters, bolted directly to the spindle flange. The spindle is driven by large bevel gears of a coarse pitch, power being derived from the regular boring bar of the machine. The milling head can be fed along the rail either by hand through the rack and pinion movement, or by the power traverse of the boring bar, and all vertical adjustments can be made by either hand or power, as may be desired.

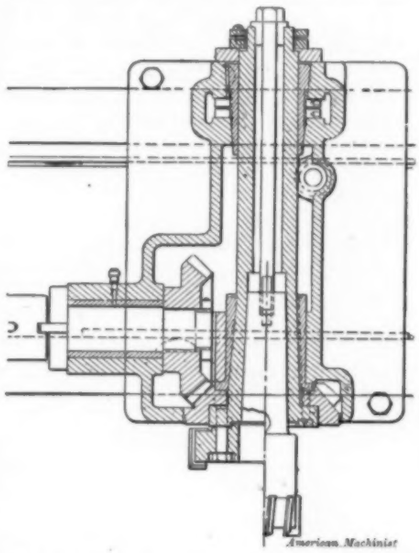


FIG. 7. DETAILS OF VERTICAL MILLING SPINDLE

The inserted-tooth milling cutter shown is 12 inches in diameter, and it will readily be seen that the combined movement of table and platen gives this form of the machine an extremely wide range for surfacing work.

To keep tools clean and bright rub a little mercurial ointment over them, which will form a moisture-resisting coating. Mercurial ointment is also known as blue butter. It is somewhat poisonous. Another good mixture to keep tools from rusting is made by taking six parts of lard and one part of rosin. Heat these together slowly till the rosin is all melted. The mixture had better then be taken out into the open air for fear of fire and benzine added in about the proportion of one pint of benzine to half a pound of the lard-rosin mixture. When cool the mixture can be rubbed lightly over the bright steel articles. Tools thus treated will resist the corrosive action of even salt water.

Efficiency of Shop Training in Schools

By L. J. Rodgers *

An instructor who believes in making real machines or parts instead of models; who realizes that shop schools are not taken seriously by employers and who would introduce practical shop conditions into them.

A plea to plan work in industrial schools calculated to turn out skilled mechanics—not engineers.

*Principal, Technical Evening High School, Buffalo, N. Y.

We are indebted to the engineering profession for one of the greatest words of modern times—"Efficiency." For many years it was used only in describing the performance of a steam boiler, engine, or water wheel. Later it was more freely used by the profession in working out clearly a comparison of different shop tools and methods. For example, we found that a lathe tool was most efficient as a remover of metal when it was forged, tempered and ground according to Mr. Taylor's rules, and when it was worked at such speed and feed that regrinding was necessary every 20 minutes. At the present time the word with its first meaning unchanged, is applied by people in every vocation to almost every conceivable phase of life.

At a recent State teachers' meeting, the writer was especially struck with the very frequent use of the word. It was "efficiency of equipment," "efficiency of methods," "efficiency of food values," and in fact, efficiency of almost everything that one could mention, excepting only efficiency of the teacher himself. Was it taken for granted that the efficiency of the teacher, like that of the modern prime mover, is so high that no important advance can be made until a revolutionary discovery of some sort is made?

The writer is persuaded that this question might be of interest to readers of your paper, because of the stand you have taken upon industrial education.

The clearest and best definition of efficiency is:

$$Efficiency = \frac{What\ you\ get\ from\ a\ given\ unit}{What\ you\ pay\ for\ (or\ system)}$$

The Cost of Education

Let us try to apply this formula to a teacher of shop work in any of our numerous technical or vocational schools. That the word "education" suggests immense sums of money yearly expended, no one doubts. Hundreds of millions of dollars are collected and spent for public education in the United States, during each and every 12 months. Of all forms of education, mere book education is cheapest, and shop training is most expensive of all. The latter means large sums tied up in equipment, great running expenses and small classes. No argument is needed to prove that the per capita cost of training pupils in shops is very high. So much for the denominator of our formula.

What about the numerator in the above expression? Is it as large as one could reasonably expect? Is it too much to expect that the boy from a vocational or industrial high school should be immeasurably above the output of the classical high school in meeting the problems of the shop? That he is more capable in meeting real life, no one will deny. But the difference is far too small.

The manufacturer has a right to look to industrial schools of any grade for boys who are more at home in overalls than in fancy shirts and the latest ties. He has a right to expect a technical high-school boy not only to know how to set a taper attachment or gear up the miller to cut a spiral, but he has a right to expect that boy to clean and oil the machine far better than would an untrained boy. The technical-school boy in whom so much is invested should be able to think out and work any ordinary shop problem without gear plates on instruction cards, and that while the cut is on.

That the shop owner would be disappointed in almost every one of these reasonable expectations no one can deny. This is generally known and is proved by the fact that many technical-school boys say nothing of school-shop experience in applying for work.

Where Education Didn't Pay

This point is well illustrated by two classmates who graduated at an eastern trade school. A, who was much the better workman, went to work as a school graduate at $10 per week; B worked in a small shop for a few weeks and then applied to A's employer, never mentioning school work. He was put on at once at $18 per week and worked beside his classmate at this great difference in rating. Is it any wonder that a shrewd boy says little or nothing of school-shop experience?

Without doubt the teacher is responsible for many of the ills of the present system, and he alone can bring about much needed changes. Let the teacher remember that if the above formula for efficiency be applied to the machine of which he is the most important gear, that its value depends as much upon the "input" as upon the "output." The cost of equipment and running expenses could, in many cases, be cut down to advantage, for some fine schools are over equipped.

As to the output, the boy himself. He leaves a splendidly equipped shop and a teacher whose main business in life is to keep clean, and if the boy is fortunate, secures a job in a very business-like shop with simple, work-a-day tools. Is it the boy's fault if he does not in any way fit these real conditions for which he has had no real preparation? Is it not beyond any question that if the school shop deliberately copied the best modern commercial shops, in equipment, in methods, and above all, in actually doing something worth while, the boy would be worth far more to a shop manager and yet lose nothing in mental development? Indeed, if it requires gloves, play exercise and fancy equipment to educate boys technically, the writer is of the opinion that it would be far better to send the boy to the manufacturer direct, and without that kind of training.

Cut Out Models and Make Real Things

Let the instructor cut out every "model" unless it involves some important operation which cannot be applied to the making of some desirable, useful product. In the machine shop, many simple useful things, such as bolts, arbors, parallel strips and "V" blocks, involving every conceivable operation or principle, are just as efficacious as many wonderful "models." After this a full-size drill press or engine lathe can be built readily—if the instructor himself has any ability as a machinist and manager. This is not a mere dream, but is easily proved to be practical by the fact that it has been done most successfully in a few schools.

This is not advocated, as some might think, because it is a cheap method—a means of making the boy pay his own way—but rather because it is the only way in which the best training can be secured. Dean Russell has well said concerning industrial education, "The economic value of the product determines the educative value of the process." If this be so, what can be said of the training which depends upon the making of foolish and highly polished "junk"?

My fellow teachers do not really believe in the absurd "models" so frequently used. They are used because it is such an easy system; for then it mat-

ters litttle if every exercise in the class is spoiled on a given day—"Get a new piece of stock and start again." Suppose, on the other hand, that six of the boys are working on important castings for an engine lathe. Would the teacher go home contented and happy if they were all ruined, or even a single large casting utterly spoiled? Would he joyfully tell the school authorities that he had "lost out" on the most important casting, and that a new start would have to be made in building the lathe? It is this actual, *real* responsibility that is the one thing needed to make both teacher and boys do their best work. No one ever did his best work in a careless, carefree manner.

MAKE MECHANICS—NOT ENGINEERS

Let us turn for a moment to one of the many large corporations which have done something toward the definite, systematic training of employees. I quote from a recent report of the apprenticeship system of a large railroad: "Our object is not to make mechanical engineers, but to make first-class skilled mechanics, to recruit our shop forces with trained men." Again, "The cost of instruction, taking all elements into account, is about 22 cents a day per apprentice, which, added to the average rate of $1.35 per day, brings the daily cost of these boys to the company to $1.57. Taking into account the time spent by apprentices under instruction, about 70 per cent. as much work is accomplished at this rate of pay as is obtained from the $3.40 to $3.60 rate to full-paid mechanics—thus proving that it is a paying proposition in itself." What a pleasure it is to read of such a clear, definite purpose in the training, and to have equally clear proof of the high efficiency of the methods used.

Finally then, summing up, let us bring the plans and methods of the commercial shop into the industrial schools. Let these schools manufacture a great deal of their own equipment and that of strong, plain designs. Let them do their own repairing—and all this not so much to save money, as to turn out *men*, trained and educated to be useful at once in the best modern shops.

Above all, let the teacher talk less of his university education, higher salary and permanent contracts and let him deliberately set about proving that he is worth more than he at present receives. Then, and only then, can he point with pride to the efficiency of the system of which he is the center.

Weighing Small Parts

BY S. KIRLIN

In machine shops, as well as in many other places, it is frequently desired to ascertain the exact weight of small pieces of castings, etc., and with the ordinary kind of platform scales generally used in these places it is impossible to weigh anything less than 5 or 10 pounds with any degree of accuracy. In machine shops especially, where the scales are used for weighing pig iron, heavy castings and subjected to the rough treatment usually given to them, it is practically impossible to weigh anything less than five pounds accurately.

Here is a method by which small parts weighing from a fraction of a pound up to several pounds may be weighed with extreme accuracy on almost any size of scales.

Slide the weight on the scale beam back to 0 and remove the weights from the beam in the same manner as when "balancing" them. Now, hang the small piece that is to be weighed on the end of the beam from which the weights were removed; next pile enough iron, or any other heavy material, on the platform until it just balances the small piece on the end of the beam. Now remove the small piece from the end of the beam and weigh the iron on the platform in the usual manner; divide this weight by the "ratio" of the scale and the product will be the exact weight of the small piece.

The "ratio" of the ordinary small platform scales is usually 100 to 1; that is, a weight of one pound on the end of the scale beam will just be balanced by a weight of 100 pounds on the platform. This ratio on larger scales may be 200 to 1 or greater.

Example: Suppose there is a small piece to be weighed; first remove the weights from the end of the scale beam, slide the weight on the beam scale back to 0 and see that the scales "balance." Now hang the small piece on the end of the beam from which the weights were removed and pile enough scrap iron on the platform to just balance the small piece. If the iron on the platform is found to weigh 175 pounds and the ratio of the scales is 100 to 1, then divide this 175 pounds by 100 and obtain 1.75 as the weight of the small piece.

I hear someone ask how you would go about it to find the ratio of the scales in case you did not know what it was.

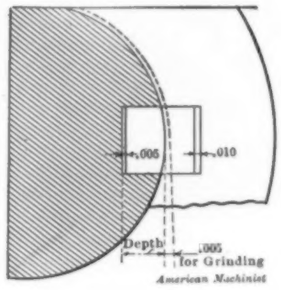
This is easy. If you live east of the Missouri river, just lay your pound plug of "terbacker" on the end of the beam and see whether it requires 100 or 200 pounds on the platform to balance it. Or, if you are west of the above mentioned stream, where everybody carries a "Colt 45" (except when they go to church), you can use it for a test weight, as everyone knows that the regulation Colt "peacemaker" weighs exactly two pounds.

Total Keyway Depth

Some years ago we published a table showing the hight of the center of the arc above a line drawn across the corners of a keyway cut into shafting of varying diameters. This gave the amount to be added to the side depth of the keyway, and we have had many favorable comments in regard to its usefulness.

The table given herewith gives the total depth from the outside of the shaft to the bottom of the keyway, allowing 0.005 inch for clearance below the key. This enables an operator to easily measure the total depth of his cut from the outside of the shaft to the bottom of the keyway, by simply noting the graduation in thousandths on the adjusting screw.

This represents the practice of the Lucas Machine Tool Company, Cleveland, O., who add 0.005 inch, the allowance for grinding, when the shaft has been rough turned and not ground to the finished size. It will also be noted that they allow 0.010 inch clearance in the hub or sleeve to insure the key bearing only on the sides.



Shaft Diameter.	¼" Key.	5/16" Key.	⅜" Key.	7/16" Key.	½" Key.
⅞	0.163				
⅞	0.155	0.203			
1	0.154	0.199			
1	0.152	0.196	0.244		
1	0.150	0.193	0.239		
1	0.148	0.190	0.235	0.282	
1	0.146	0.188	0.232	0.278	
1	0.145	0.186	0.229	0.274	0.322
1	0.144	0.184	0.227	0.271	0.318
1	0.144	0.182	0.224	0.268	0.313
1	0.143	0.182	2.223	0.266	0.310
1	0.143	0.181	0.222	0.264	0.307
1	0.142	0.180	0.220	0.262	0.305
1	0.142	0.180	0.219	0.260	0.303
1	0.141	0.179	0.218	0.258	0.300
1	0.141	0.178	0.217	0.257	0.298
1	0.141	0.177	0.216	0.255	0.296
1	0.141	0.177	0.215	0.253	0.295
1	0.140	0.176	0.214	0.252	0.293
1	0.140	0.176	0.213	0.251	0.292
1	0.140	0.175	0.212	0.250	0.291
1	0.139	0.175	0.212	0.250	0.289
1	0.139	0.174	0.211	0.249	0.288
2	0.138	0.174	0.210	0.248	0.287
2	0.138	0.172	0.209	0.247	0.285
2	0.137	0.172	0.208	0.245	0.283
2	0.137	0.171	0.208	0.244	0.282
2	0.136	0.171	0.207	0.243	0.280
2	0.136	0.170	0.206	0.242	0.279
2	0.136	0.170	0.206	0.241	0.278
2	0.136	0.170	0.205	0.241	0.277
3	0.135	0.169	0.205	0.240	0.276
3	0.135	0.169	0.204	0.239	0.275
3	0.135	0.169	0.204	0.239	0.274
3	0.135	0.169	0.203	0.238	0.274
3	0.135	0.168	0.203	0.238	0.273
3	0.134	0.168	0.203	0.237	0.272
3	0.134	0.168	0.202	0.237	0.272
3	0.134	0.168	0.202	0.236	0.271
4	0.134	0.167	0.202	0.236	0.271

ADD 0.005 WHEN ROUGH TURNED.

KEYWAY DEPTHS FOR FINISHED SHAFTS.

Microscope in the Hardening Room

By E. C. Peck*

The cause of erratic behavior of steel made plain and the method of obtaining uniform results with the microscope.

*General superintendent, Cleveland Twist Drill Company.

The story of a photograph of a ginger snap which was palmed off for a photomicrograph of a piece of steel has gone the rounds and has, no doubt, caused some mirth and unjustly ridiculed the efforts of a set of men too high up in the scientific world and too dignified to even notice some of the ignorant comments made about it.

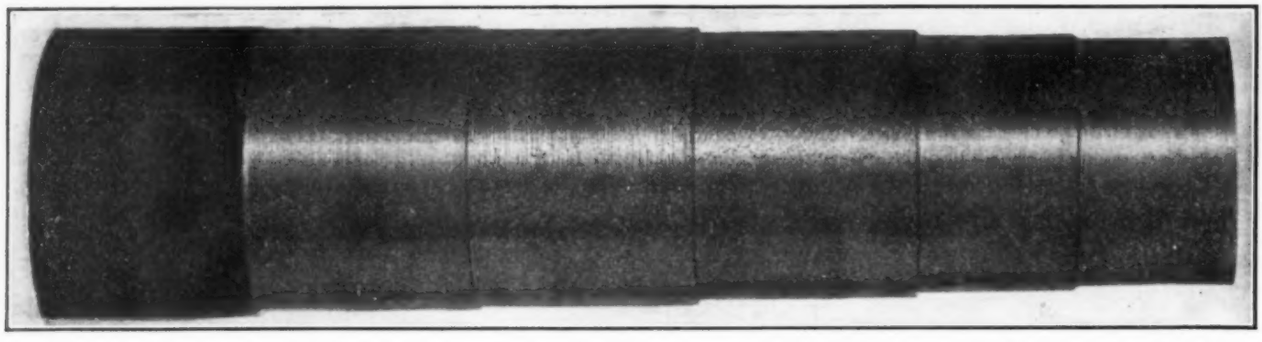
It is a safe prophecy to say that the microscope in the hands of intelligent men, aided by chemistry, is going to be one of the foremost factors in producing good and uniform products in the metal industry. Its introduction will probably be slow, owing, no doubt, to the large amount of study needed to be able to get results, but I believe that all who have taken up metallography and stuck to it long enough, have been more than repaid for the time spent in acquiring the knowledge needed to apply it to their line of business.

This article is intended to show some of the benefits that have been derived from the use of the microscope in the works of the Cleveland Twist Drill Company, in whose plant the data mentioned have been collected.

I have contended for a number of years that there is a certain property in a cutting tool that does not always bear a direct relation to the analysis and hardness of a tool. Not knowing the cause of this, and for want of a better name, I call it "cutting quality." Hundreds, and perhaps thousands, of samples which gave substantially the same analysis and hardness, gave cutting tests varying by as much as 75 per cent. This led me to try to find the cause or causes for this phenomenon. Consequently considerable study and research has been made in the last few years to collect data that might throw some light on the subject.

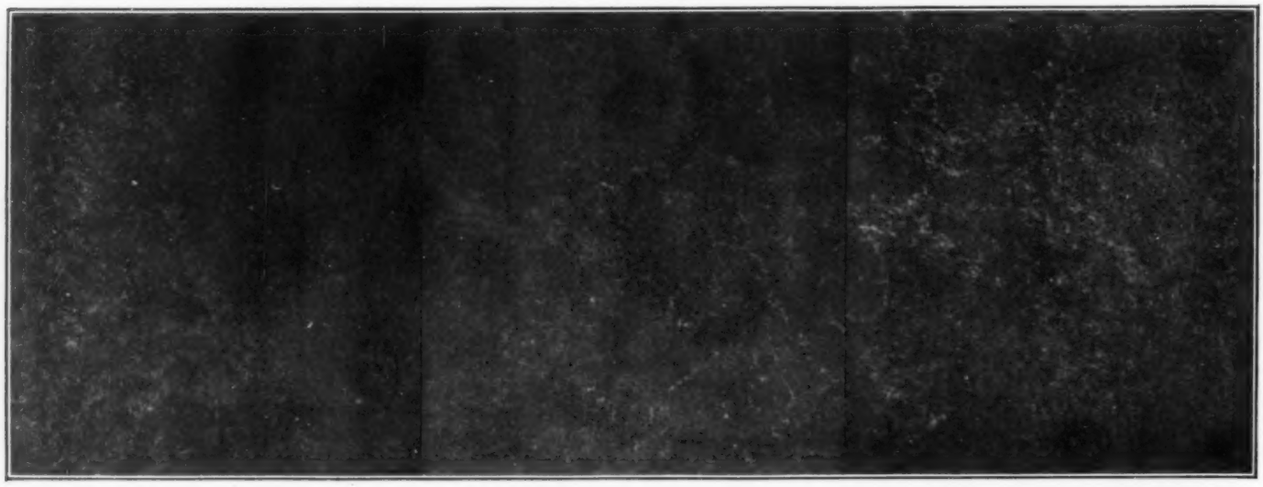
Variation in Tests

The statement—substantially the same analysis and hardness—will probably immediately raise a question of the accuracy in determining these two important factors. This may be owing to the difference in the results obtained by chemists and the lack of a thoroughly reliable apparatus for measuring hardness. However, if three reliable chemists in different parts of the country each analyze a part of the chips from the same piece, checking with standard steels, and obtain the same results within very close limits, it seems fair to assume their analyses are nearly correct. If the hardness is measured by two of the best known methods and the results agree closely, in several comparative tools



A B C D E

Fig. 1. Action of Tool at Different Depths of an Annealed Bar



A B C D E

Fig. 3. Photomicrograph of Cross-section of Bar at Different Depths. The Total Depth Represented by the Length of the Illustration is 0.120 Inch

measured by both methods, the combined error of inaccuracy of these two factors ought to be very small.

When the above mentioned variation in the actual work done by tools checked by this process is almost an everyday occurrence, it is evident that other factors must enter into the steels to make one so much better than another. I firmly believe that a modern uptodate hardening plant, working on a known steel and following a few well defined rules, will give tools a heat treatment conducive to more uniformity than most of us believe, if the condition of the steel is correct before hardening.

Annealing

Experiments during the last three years warrant the statement that two-thirds of the troubles in tools are caused by trying to harden steel that is not in the proper condition. This is usually due to faulty annealing or manipulation in the steel mill. If the steel contains the right elements and these are in the proper proportions, it can be put into proper condition for making good tools in the majority of cases.

The process of annealing has been so clearly defined and the rules for carrying it out so firmly laid down that it seems a very simple operation, yet to do it properly and be sure of results is a problem of some magnitude. Besides being in a condition to machine only, the steel must have the proper grain size or structure. Unless a considerable portion of the outside is to be removed, it must also have only a small amount of "bark."

Steel makers advocate the annealing of their steel before hardening, if they do not anneal it at the mill. All tool steel is improved in hardening quality by proper annealing. Hardening the second time usually improves the tool if so done that the surface is not decarbonized.

During the past fifteen years I have had to do with the hardening, and a large part of the annealing, of some 10,000 tons of tool steel. I have, therefore, had a good opportunity to witness the performance of a great many different men's ideas of annealing. This assures me the range from good to bad has been pretty well covered. As already stated, a well annealed piece of steel should machine easily, have the structure in proper condition and be fairly free from bark.

The Microscope

The best way I know of to prove and to know that the steel is in this condition is to polish and etch a specimen and examine it with a microscope. This instrument, in the hands of a trained and skilled man, will tell definitely if any one, or all three, of the above conditions are present in a specimen. If not, it is easy to determine what should be done to the steel to produce these conditions.

Once a known steel of established analysis is heat treated to get these three conditions, it is not a difficult matter, with the proper facilities and checking, to produce them regularly.

Variation of Quality with Depth

The microscope has been the means of definitely determining what is the trouble with annealing, as done by many reputable concerns. An instance will illustrate this. Tons of steel have been sent back to be reannealed as it turned so hard that the sizes could not be maintained, although the steel would work perfectly when getting ⅛ to ¼ inch below the surface. Reannealing to make the surface work properly, usually made the interior work hard or be unfit for tools. Expert steel workers were at a loss to account for it, until the microscope not only solved the annealing problem, but produced a great improvement in the tools.

Hundreds of specimens of annealed steel have been examined, annealed by different concerns, and they all showed that the annealing had produced a bark from 0.010 to 0.112 inch in depth. The deep bark on the outside is pure iron, which

Fig. 2. Magnified 3 Diameters

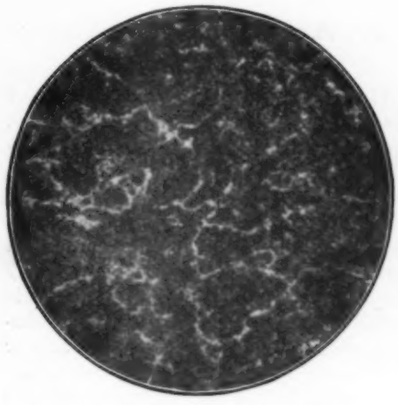


Fig. 4. Magnified 70 Diameters

Fig. 5. Magnified 70 Diameters

Fig. 6. Magnified 400 Diameters

Fig. 7. Magnified 400 Diameters

Fig. 8. Magnified 400 Diameters

is soft. This gradually runs into steel with a carbon content of 85 to 90 points, which is about the hardest kind there is to anneal, and finally into the full carbon of the bar.

One of these badly decarbonized bars will turn very easily if the tool is set for a cut about 0.01 inch deep. If set to cut 1/32 inch deep, so that the point of the tool is in that part of the steel containing from 85 to 90 points carbon, it will wear the tool out in a short time and can scarcely be turned at all. At a greater depth than this it again turns quite easily.

Photomicrographs

Fig. 1 shows such a bar nearly full size, special attention being called to the difference in the appearance of the surface of the steps, which were all turned with the same tool specially hardened for the purpose. When turning portion

Fig. 9. Magnified 700 Diameters

A the tool was in the bark, which is practically pure iron, while portions *B*, *C* and *D* show progressively deeper cuts and the corresponding structure, while *E* shows the bar turned with a deep cut and its structure at that point. Fig. 2 shows a fan-shaped radial section of the bar magnified three diameters, the bark being clearly seen. Fig. 3* is a photomicrograph of a cross section of the bar, the appearance at the different depths being shown by letters *A*, *B*, *C*, *D* and *E*, which correspond with the same letters in Fig. 1.

It is, of course, obvious that any tool made from this bar, which would have a cutting edge in one of the surfaces, *B*, *C* and *D*, would be very likely to prove a failure, owing to its carbon content and also its structure.

Fig. 4 is a micrograph of a piece of annealed steel as received from the steel mill. A tool made from steel in this condition would be a perfect candidate for cracking in the hardening operation, the rupture taking place along one of the well defined lines.

Fig. 10. Magnified 400 Diameters

Fig. 5 is a micrograph of a piece of the same steel properly treated to break up the cemenite. This structure is particularly strong and even delicate tools can be hardened with very little risk of breaking and, what is of more importance, the tools with this structure do more work and the tests show a marked uniformity in "cutting quality." Nearly all tools examined which were lost in the hardening operation showed a structure similar to that of Fig. 4. Some exceptions are tools made from unknown steels, the heat treatment of which is given by the customer. An examination of those usually shows that a little too high a heat was used.

Figs. 6, 7 and 8 are micrographs of three tools of the same size and kind and

Fig. 11. Magnified 400 Diameters

are very typical of the "cutting quality." The amount of work done by these tools was respectively 40-30-15 units of work.

Fig. 9 is a micrograph of one of the best tools of its size and kind ever tested for the writer. It is also the finest specimen of carbon steel for structure ever examined at this plant, requiring a magnification of 700 diameters to get even the small spots shown.

Fig. 10 represents some annealed steel as received from the mill, which required some forging on the portion to be used for the cutting end.

Fig. 11 shows the structure of this steel in the tool end after forging and without special heat treatment. This clearly shows that careful working at the right temperature materially improves the structure, a point on which most steel men agree.

Fig. 12 shows the structure of a piece of steel as it was received from the mill and is about the worst specimen I have ever seen. This steel was not only piped but badly over-heated. The extremely dark spots are holes in the bar, probably due to the piping. Steel with a structure like this might be said to be the kind which explodes. In other words, in the hardening operation it splits asunder

Fig. 12. Magnified 100 Diameters

longitudinally with a report not unlike that of a cannon.

A. S. M. E. Greetings to Captain Hambellton

An informal committee of the 1910 Trans-Atlantic party of the American Society of Mechanical Engineers entertained Capt. A. E. S. Hambellton, of the steamship "Celtic" at luncheon on January 17 at the Engineers Club, New York City.

The "Celtic" was the ship upon which the mechanical engineers went to England last summer at the time of their joint meeting with the British Institution of Mechanical engineers at Manchester, and this luncheon to Captain Hambellton was given as a token of the high esteem in which he is held by the members of the party.

Professor F. R. Hutton extended the felicitations of the members to the Captain in the form of a wish that he may continue to meet with the success he so well deserves.

*The reader will understand that the inevitable loss of detail due to the reproductions involved in the halftone process makes these illustrations far less satisfactory than the direct view of the pieces obtained through the microscope.—Ed.

Planer Jigs, Gages and Other Tools

By F. A. Stanley

The halftone and line engravings presented herewith illustrate a few of the many useful special tools and appliances utilized at the shops of the John B. Morris Machine Tool Company, Cincinnati, O., in the building of its engine lathes. These tools include planer fixtures for holding various lathe parts, one or more at a time; gages for setting planer tools for finishing such parts and for testing the accuracy of the work after planing; milling fixtures; novel forms of plug and ring gages, and other devices of interest to tool designers and users.

A simple set of fixtures for holding lathe tailstocks by the ends of the barrel while planing off the bearing surface for the base.

Accurate dovetail gages for facilitating the planing of the sliding surfaces on top slides, swivels and bottom slides of compound rests. Plug and ring gages with key and keyway respectively, for testing change gears and their studs.

Some simple milling fixtures, special boring tools, and a hand-operated graduated machine for circular work.

Fixtures for Planing Tailstocks

The planer fixture in Fig. 2 is one of a set of twelve, placed, when in use, in a row on the planer platen for machining the lower surfaces of tailstock tops. A tailstock casting is shown to the left in the view, with an empty fixture in the center of the group, and a casting in position as it is actually held for planing, at the right.

The idea is to chuck the work so that it shall be planed in the correct relation to both ends of the rough barrel, which in a later operation is bored out to receive the tail spindle. It is desirable that the casting be located from the rough barrel ends as this will assure the hole for the spindle being bored central with the casting, making a neat appearing piece of work when viewed from either end.

The planer fixture is fitted, as indicated, with cup centers to receive and locate the tailstock casting by the ends of the barrel, the cup at one end having an end movement controlled by a set screw, to bind the work longitudinally in the fixture. There are three jack screws which are brought up under the projecting base of the casting. Two of these are located at the left side of the fixture and, when the string of fixtures are placed upon the planer, they are set crosswise with the single supporting screw in advance so that the pressure or thrust of the cut is taken upon the two screws under the opposite side of the casting.

The fixtures are located square upon the planer table by means of the tongue at the underside. After the bearing face of the tailstock has been planed and the groove planed across for the reception of the tongue on the upper surface of the bottom plate, the tailstock is scraped to its bottom plate and the hole for the spindle is then bored in a fixture which brings the hole parallel to the base, square with the crosswise tongue and central with the projecting hubs or barrel ends.

Planer Templets and Dovetail Gages

The gages in Figs. 1 and 3 are used for setting planer tools for planing the top slides, swivels and bottom slides for compound rests, and also for testing the accuracy of the planing operations. Thus in Fig. 1 a gage set consisting of members *A*, *B* and *C* is illustrated as used in connection with the planing of the dovetail and gib bearing surfaces on the top slide *D* and swivel *E*. As here shown the two dovetail gages are adapted for the setting of the planer tools and in actual service are clamped to the platen at the end of a long row of castings. These gages are of steel, hardened, ground and lapped.

Considering for a moment the application of the gage or templet *A* for the top slide, the castings are first roughed down on the top surface, then turned over to the position shown. The setting gage *A* for the tool is placed on a thickness or two of paper and the bottom of the slide, the dovetail surface and the straight surface and groove for the gib are roughed down and finished, the tools being set to

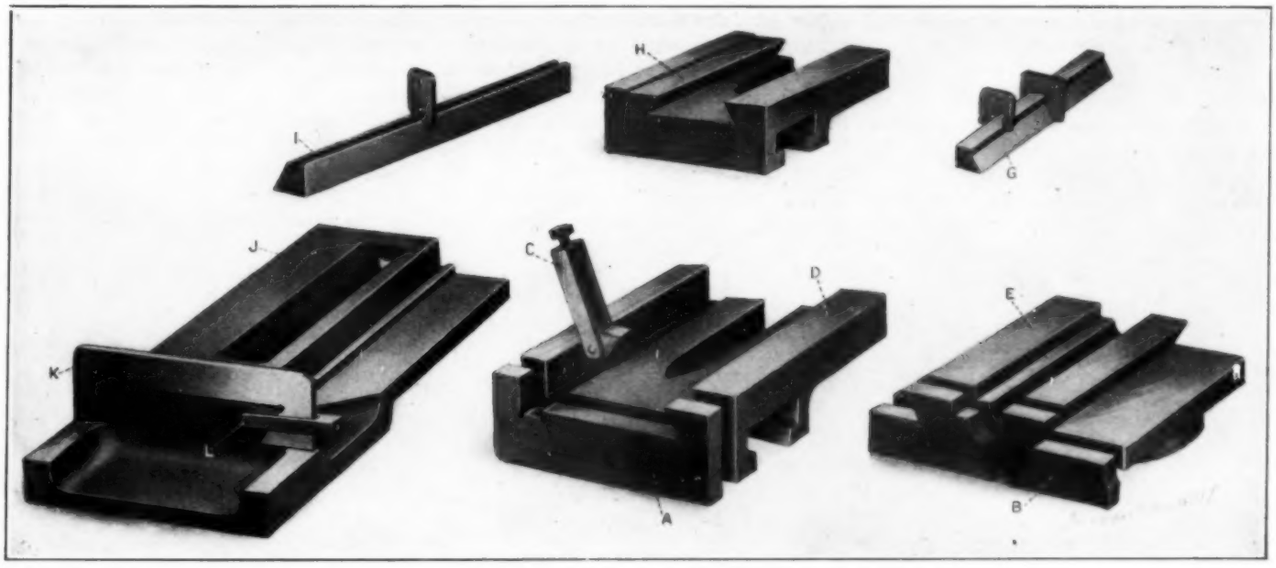


Fig. 1. Dovetail Planing Gages

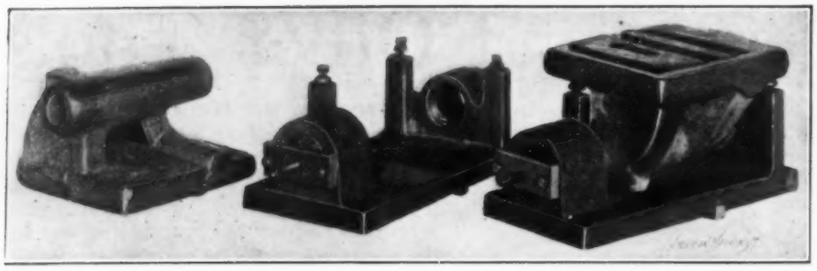


FIG. 2. PLANER FIXTURES FOR LATHE TAILSTOCKS

the hardened gage edges for the finishing cut. When the work is turned over for finishing the top surface the gage is turned and clamped directly on the platen, without the paper underneath, and this drops the gage or templet just enough so that the tool, when set to the top of the gage, will take a finishing cut over the work. The dovetail gage *B* for the swivel is made use of in similar fashion.

drawing, Fig. 4. The gib fits nicely against the vertical wall of the top slide and in the groove in the bottom of the slide, and the adjusting screws tapped in from the top, by which it is held in place, enable it to be drawn into its seat as far as required at either end to take up thoroughly any wear that may take place.

THE FORM OF THE GIBS

A word may be said here about the gibs for these slides. The shape of the top slide gib is well shown at *G*, Fig. 1, and a gib of this type will be seen in place at *H*, Fig. 1, and also in the end view in the drawing, Fig. 4. The gib fits nicely against the vertical wall of the top slide and in the groove in the bottom of the slide, and the adjusting screws tapped in from the top, by which it is held in place, enable it to be drawn into its seat as far as required at either end to take up thoroughly any wear that may take place.

The gib *I* for the bottom slide *J*, Figs. 1 and 3, has a tongue on the inner edge that fits into a groove formed behind the narrow tongue on the slide itself. The nature of the fit is represented in Fig. 4, which shows the clearance provided between the front of the groove in the gib and the corresponding face of the tongue on the slide. This construction allows the gib to be drawn up perfectly true and square with its screws without possibility of cramping, and, as with the top slide gib referred to, adjustment for wear is readily effected.

GAGING THE WORK

The gages for these gibs are shown on the work in Figs. 1 and 3. It will be noticed in the case of the bottom slide gage *K* that this gage is first used as in Fig. 1 to test the accuracy of the dovetail surface at one side and the straight surface at the opposite edge for the gib, and then the inserted section *L* is removed from the gage and the open dovetail gage applied to the slide with the gib in place, as illustrated in Fig. 3. Thus the gage with its inserted jaw answers for the slide test with and without the gib.

Returning now to the gages for the top slide and swivel, these are actually applied to the bearing surfaces in the work as indicated in Fig. 3. Here the gage *A*, which was shown in Fig. 1 as used for a planer templet for the bearing surface of the top slide, is represented in place on the dovetail guide of the swivel. The gage block *C* is carried by the main gage *A* to represent the gib while gaging this

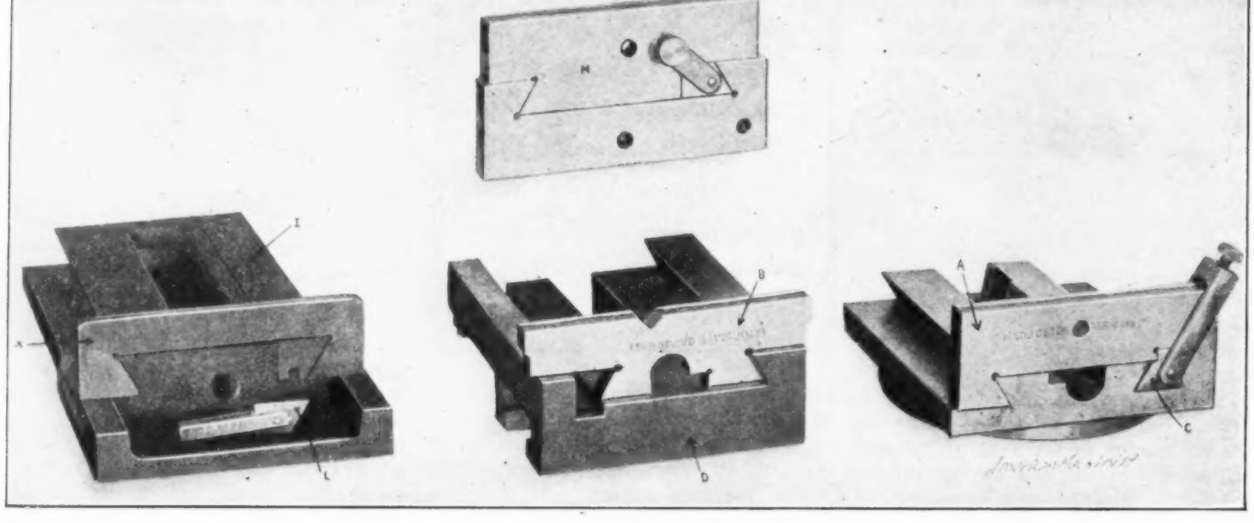


FIG. 3. DOVETAIL PLANING GAGES

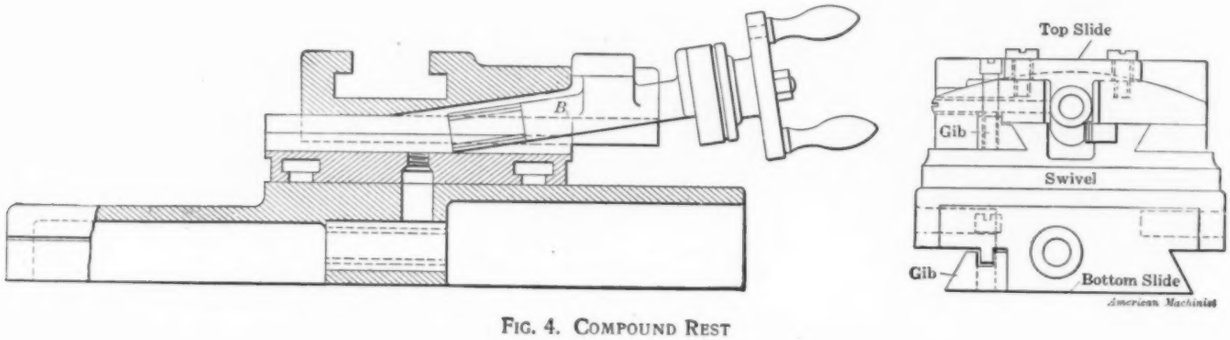


FIG. 4. COMPOUND REST

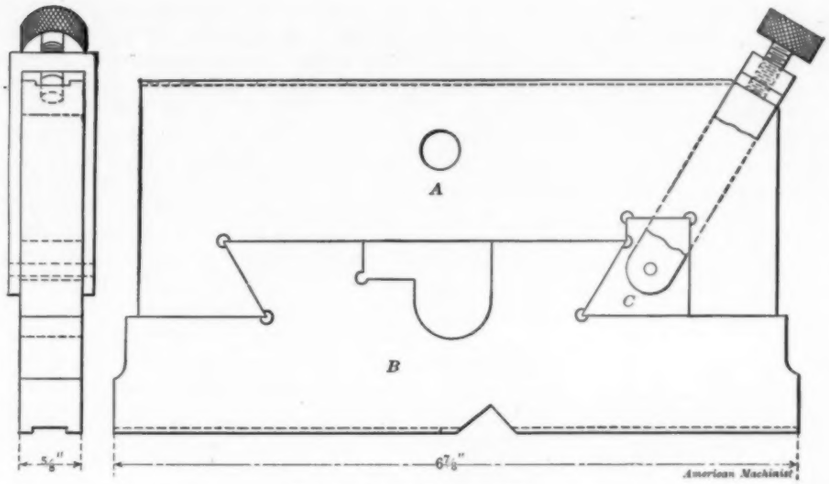


FIG. 5. GAGE ASSEMBLED

dovetail bearing, and this same auxiliary block *C* may also be attached to gage *B* for testing the full width of the bearing surface and gib seat in the top slide *D*.

The gage completely assembled is illustrated in the sketch, Fig. 5, and this shows how the removable block *C*, which represents the gib, may be attached to either the male or female dovetail gage. In the sketch the block is connected to gage *A*, but upon releasing the thumb screw at the upper end of the link, the latter may be swung down to allow the block *C* to be withdrawn from its seat. To attach the block to gage *B* the locking link is swung around to bring the clamp screw against the notched seat at the bottom of the gage.

These gages are finished so nicely as to fit perfectly at every point in the joint. They are relieved along the edges that rest upon the planer when used as tool-setting gages, leaving two bearing surfaces about ⅛ inch wide. Another set for a different size of lathe rest is shown at *M*, Fig. 3. The removable block in this case is drawn into place in either of the main members by a nurled-head pin which has an eccentric body fitting the hole in the gage. A slight turn of the pin draws the block up snug in its seat or releases it.

SPECIAL PLUG AND RING GAGES

Some plug and ring gages for testing change gears and their studs after the keyways are cut in the gears and the keys inserted in the studs, are illustrated in Fig. 6. Three sets of plugs and rings are shown in the group; a plug and ring together at *A*, a plug and ring separate at *B*, a ring on the stud bearing at *C* and a plug in the change gear at *D*. It will be noticed that each plug is fitted with a key and each ring provided with a keyway so that when applied to the change gears and studs they test the accuracy of the keyway and key respectively, in those parts.

As the bore of the gears is made a perfect fit for the cylindrical portion of the plug gage, and the key in the latter is located dead in the center, the keyway in the gears must be absolutely central to allow the gage to enter, for there is no clearance between the sides of the key in the gage and the sides of the keyway. Similarly, the ring gage with its centrally located keyway makes it impossible for a stud to pass inspection if the key in the gear bearing at the end of the stud is not located exactly in the center.

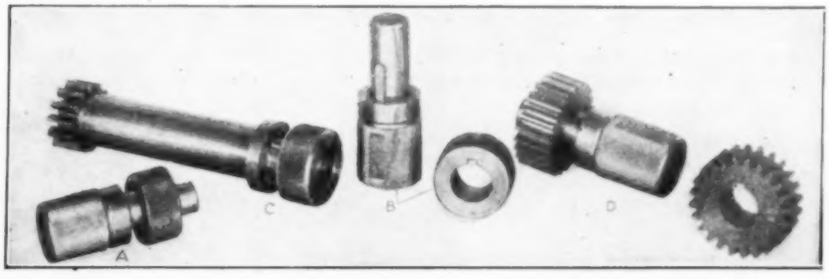


FIG. 6. PLUG AND RING GAGES FOR CHANGE GEARS AND STUDS

SOME MILLING FIXTURES

Two fixtures are shown in Fig. 7 for holding the feed bracket of the compound rest while milling the faces and edges. Two of these brackets are shown at the right hand in the group and, as will be seen, the bearing is bored out at an angle to the base of the casting. The way in which this member is attached to the top slide will be understood upon reference to Fig. 4, where the bracket is shown at *B*. The feed device is really a worm, as indicated, which engages with a rack attached to the upper part of the swivel upon which the top slide is mounted; the center line of the feed shaft is at an angle of 8 degrees with the base of the bracket.

After the casting has been bored and reamed it is placed in the fixture *C*, Fig.

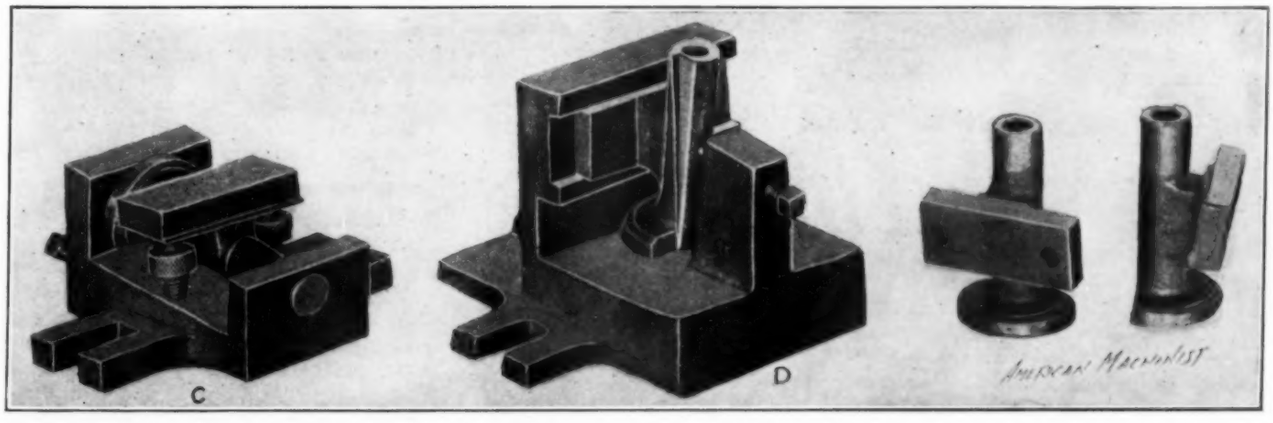


FIG. 7. SOME MILLING FIXTURES

7, for the surfacing of the top and straddle milling of the edges, a dozen of these fixtures being used in a row on the table of the miller. Here the work is slipped over a stud which is fitted at the correct angle in the fixture, and which is drawn up snug by a nut at the upper end. This positions the work at the right angle and holds it endwise, while the two jack screws under the wings of the casting level it crosswise for the gang-milling operation.

The fixture *D*, Fig. 7, receives the casting in a seat planed across the face of the fixture, and here it is held by a set screw tapped through the lug at the front. The two sides of the body, that is the wings, are then faced off with an end mill, so that the bracket will rest squarely upon its seat when attached to the top slide of the compound rest.

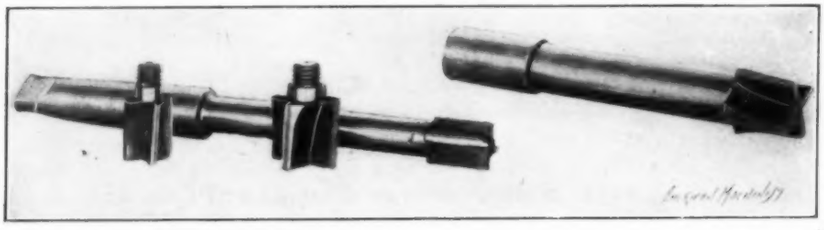


FIG. 8. TURRET LATHE AND DRILL-PRESS TOOLS

FOUR-LIP TOOLS WITH DETACHABLE ENDS

The detachable tools in Fig. 8 are of the four-lip type for boring out cored work, enlarging holes, etc. They are made in two forms, for the drill press and turret lathe respectively. The cutting head has a short cylindrical hub, fitting closely in a hole bored in the end of the shank, the threaded portion being a free fit in the tapped hole in the shank. The inner end of the cutter is ground square with the hub and when screwed into place the tool runs true with its shank.

A number of cutters of various sizes are made for use with each type of bar illustrated.

A GRADUATING MACHINE

The graduating machine, Fig. 9, is illustrated as set up for dividing the edge of the swivel ring of the compound rest. It is adapted for operating upon a variety of circular work which is of a size suitable for mounting upon the rotary table.

The manipulation of the one handwheel does all the work. This wheel rotates a shaft with a slotted crank at its inner end and the location of the crank pin in this slot determines the distance rack *A* shall reciprocate. The rack actuates a sleeve which has a pawl carrier *B* at its rear end and the pawl acts upon a ratchet wheel that drives the worm shaft *C* for rotating the work table. The table is thus given an intermittent feed, the angular advance at each step being determined by the number of teeth covered by the pawl in its oscillation derived from the rack *A*.

The graduating tool is carried by a relieving holder in a slide which is reciprocated vertically by means of a cam driven by shaft *D*. This shaft is actuated by spur gears from the main shaft carrying the handwheel, and is splined so that as the head *E* is adjusted forward or back to suit the size of work to be graduated, the shaft will slide through its driving gear, and still be operative at any setting of the machine. The adjustment of the graduating head *E*, is effected by means of the nurled knob *F* which operates a screw passing through the head.

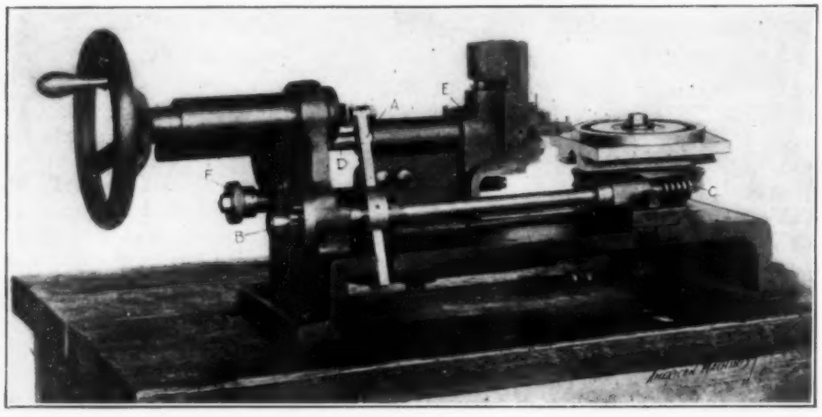


FIG. 9. A GRADUATING MACHINE

The cam for the operation of the graduating slide is made to suit the style of divisions required upon the work, repeating the series of short and long lines in conformity to the hight of the series of lobes upon the cam's periphery. Thus with the common graduation where every fifth line is to be longer than the four preceding it, the cam will have five lobes, four of which are of equal hight while the fifth will be the desired amount higher.

A simple table is used with the machine, showing just what cam to use, what ratchet is required for the desired number of lines in the circle, and how many teeth to feed on that ratchet wheel. The changes necessary in shifting from one job to another are readily made.

Saving Time by Grinding from the Black Shaft

BY J. C. SPENCE*

We had a lot of sixteen 1⅜-inch, 35-point carbon, open-hearth machinery steel shafts that were to be finished to 1 5/16x 51 inches. The question came up as to whether or not this would be a profitable shaft to grind to size, directly from the black, without any previous rough turning.

It was decided to rough turn eight shafts and leave the other eight untouched before sending them to the grinder. The entire sixteen required straightening. The eight were rough turned, the tool being fed at quite a coarse pitch so that they were turned in 5 minutes per shaft. This roughing cut sprung the shafts so that restraightening required 4 minutes per shaft. We had, therefore, spent 9 minutes more time on the turned shafts than upon the unturned ones and, in order to make the turning profitable, we would have to grind each of these turned shafts more than 9 minutes faster than the unturned ones.

The rough turning left 0.020 inch on the diameter at the bottom of the tool marks and 0.040 inch at the top of the ridges. This 0.020 inch was about as close as we dared to turn and not have to spend an excessive amount of time in straightening.

The grinding showed that the black stock pieces required only 4 minutes more time than did the rough-turned pieces. In this particular case, therefore, we would have been better off by 5 minutes per shaft, if we had ground direct from the black stock. In other words, our lathe work was all wasted time.

To find safe load concentrated at center that may be carried by a pine beam, multiply the product of the width and the square of the depth in inches, by 100, and divide by the span in feet. If the load is distributed uniformly along the beam, the total load may be doubled. This gives an ample factor of safety for first-class Southern pine. Spruce will hold only three-quarters as much as pine.

*Superintendent, Norton Grinding Company.

Non-adjustable Cast Iron Bearings

By W. M. Byorkman *

Repeated and long continued experience shows the remarkable durability of cast iron bearings under high speed.

*Chief draftsman, the Underwood Typewriter Company.

The superiority of cast iron as a material for bearings is pretty generally accepted, but for some strange reason but few manufacturers of machinery have the courage to use them in their products. This article is intended to show a construction which has been in use in our works in such large numbers and for such a period of time as to demonstrate again the superior virtues of this material.

The machine shown will be recognized at once as a polishing and buffing machine. The bearings are nothing but reamed pieces of cast iron, without provision for wear, but so fitted as to insure perfect alinement of shaft and bearings.

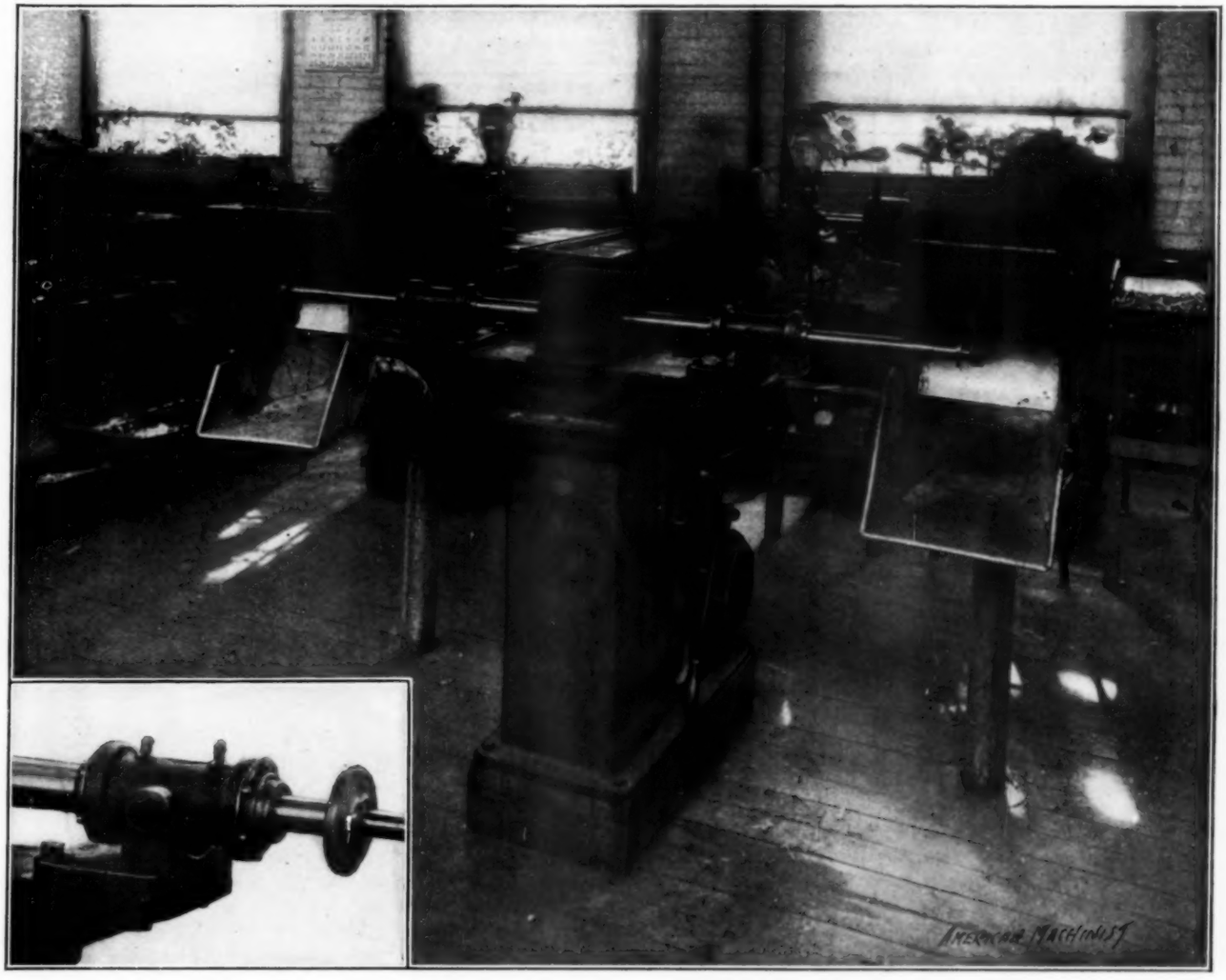
The small illustration in the lower left-hand corner shows the bearing on a larger scale than the general view. It is, as will be seen, so swiveled as to accommodate any spring of the shaft due to the pull of the belt, which comes up from below the floor. Alinement in a horizontal direction is secured by a still simpler means, nothing more than a free fit between the holding-down bolts and their holes. When assembling the machines the bolts are carefully tightened to insure correct seating of the shaft in the journals. The journals are fitted with felt washers to keep out the dirt and grit.

Overstraining the Belt Avoided

Starting and stopping of the machine is obtained by means of a weighted idler pulley inclosed in the base, the weight being so arranged that when the tightening handle is released the pulley will swing free from the belt, which latter then hangs in a loop below the line-shaft pulley. Provision is made to prevent overstraining the belt and consequent undue load upon the buffing spindle. The operating handle is provided with a latch, which works over a drilled sector, as clearly shown. A stop pin in one of the holes locates the handle at a point where the tension on the belt is sufficient but not excessive. As the belt stretches the pin is moved up the sector one hole at a time, and this very desirable condition is thus preserved indefinitely.

Durability of the Bearings

About a hundred of these machines are in constant use, some of them for a



Swiveled Adjustable Cast-iron Bearings

period of six years. In but one case have the machines even been taken apart because of trouble with the bearings, the trouble in this case being due to failure to supply oil. In no case has there been any call for adjustment because of wear. The life of the bearings seems to be indefinite, their working condition being as good today as when they were first installed. The spindles are of unannealed steel and are ground to a suitable fit.

Making, Use and Care of Belting

By Chas. A. Schieren, Jr.*

The tanning of hides for belt leather by the old, long-time, oak-bark process and the operations in making belts.

Belt specifications fair to both buyer and seller, and belting factors that have been tested by long experience. How to get maximum belt service per dollar of investment.

*Treasurer, Charles A. Schieren Company.

With the bark and the hides at hand the process of tanning to produce leather for belting may be taken up.

The hides are first soaked in pure spring water until all the dirt is thoroughly washed out of them. They are then placed in a vat of weak lime water, which is gradually strengthened until the sixth day, when the hair has been loosened sufficiently to allow the skin to be laid on a beam and the hair scraped off with a blunt knife.

The bare hides are then placed in an alkaline solution called the "bate," for the purpose of removing the lime which may have remained from the previous bath; this liming and "bating," done in a building known as the "beam house" or "lime house," is a very important step in the making of good, solid belt leather.

Cleansed from hair, flesh and lime, the hides are taken from the "bate" to the "handlers," where they receive their first bath of weak tanning liquor.

Preparing the Tanning Liquor

This liquor is prepared from oak bark. Ten years ago this bark was ground in something like an overgrown coffee mill, but our tannery has been equipped for five years past with an improved crushing machine which does the work quicker and more effectively, and as the crushed bark leaves this machine it is blown by means of a rotary fan through large metal pipes to the leach tubs.

These are 12 feet in diameter, eight feet deep, and hold fully eight tons of ground bark.

To this ground bark, water is added by means of rotary brass sprinklers, and filtering through the mass, takes up and carries downward the tannic acid.

There is a false bottom in each leaching tub, and the liquor is collected beneath it and pumped away to the storing and supply tanks for use when needed. It is from these tanks that the liquor is drawn for the handler vats in which the hides are put after the "liming" and "bating."

Tanning

The hides are placed in the handler vats across sticks side by side, packed as closely as possible, and are left here for about 10 or 12 days, during which the hide swells, opening the pores and increasing both in thickness and firmness.

When the hides are taken from these vats the bellies and heads are trimmed off and tanned separately for shoe purposes. The butt portions intended for belting are then stowed in vats called "lay-aways." Here they are laid flat, one on top of the other, about a hundred in each vat; loose bark is spread between the layers, and they are covered with strong tanning liquor.

Hides intended for belting are given five successive layers or treatment of bark. The first layer remains 10 days, and the process is graded up to 40 days for the last layer.

In this way oak-tanned belt leather is submitted to a tanning which takes 120 days for the attainment of the best results.

Drying and Finishing the Belt Centers

When the hides have thus been thoroughly tanned they are taken from the vats, washed, so as to remove every particle of tan bark, and then oiled on the grain side, hung up to dry in a darkened loft, where they are kept at an even temperature with very little heat, and gain a beautiful clear russet color. The leather, as such, is now completed, and each hide is cut into widths according to its grade and weight.

The bellies, shoulders and all flabby or imperfect parts are thrown out for shoe purposes, and the central portion or heart of the hide is reserved for belting.

This solid leather is carefully shaved on the flesh side in huge machines, operating somewhat on the principle of a milling machine, and is then scoured by other machinery. The object of this is to open up the pores for the reception of the stuffing of cod oil and pure beef tallow by which the leather is preserved and made suitable for the transmission of power.

Many hours are devoted to this stuffing, and the thoroughness with which it is done lends to belting one of its most prominent features—long life. When the stuffing is accomplished the leather is smoothed and stretched so that the fibers will be made uniform.

Nothing now remains to be done at the tanneries but to allow the leather to dry, brush it off, pack it in bundles and ship it to the belt factory.

The capacity of the Dixie Tannery, of Bristol, Tennessee, owned by the Charles A. Schieren Company, is 100,000 hides a year, and its equipment is used solely for tanning and finishing prime oak leather for belting.

The leather, centers and sides, when they reach the belting factory, are from 4⅓ feet to 4½ feet long. At the tannery, after the leather is taken out of the vats, and before the currying process, the shoulders are removed from all of the hides, and each hide is measured four feet from the butt end of the tail to the shoulder, and the shoulder cut straight across so that no piece of shoulder or flanky leather is left on the hide.

After the severe stretching which these pieces undergo during the currying process and in the stretching frames the pieces elongate from four inches to six inches, making each piece four feet to four feet six inches in length, and all of the pieces solid leather.

Operations in Making a Leather Belt

The first process at the belting factory is to select the centers and sides for thickness and weight, and cut them up into various widths for which the stock is most suitable; this is one of the most important processes in the making of leather belting.

After the leather has been cut to width it is transfered to the matching tables, where the pieces are matched in pairs and marked for the scarfing machine; this machine scarfs the laps to a length already indicated by the matcher.

From the scarfer the stock is taken to the feathering-machine operator, who feathers the edges of the laps prior to their going to the pressman to be cemented. The cement used is either our improved belt cement for regular belts to run under dry conditions, or our water-

proof cement for waterproof belting. Perfect joints can be and are made with no other fastening than cement, and in most cases riveting or sewing the laps is superfluous; joints that are cemented only have the advantage of running smoother and with less vibration than belts fastened in any other way.

The belt next goes to the finishing department, where it is inspected and where the edges are finished either round or square as the case may be. During the finishing of the edges the belt passes through a stretching device which eliminates all of the stretch or surplus elasticity that may be necessary for good running.

The belt is next turned over to the final finishing table, where the edges are burnished and the roll made up ready for shipment and sent to the shipping department.

Every center-made belt six inches in width and over takes the central portion of one steer hide for every four feet of length single ply, and two steer hides for every four feet of length double ply. A large main-drive belt made by us was 243 feet long and 72 inches wide, three ply thick. It took the best or central portion of the hides of a herd of 549 steers to make this belt. The average area of a steer hide when it reaches our tannery is 40 square feet. The head, shoulders and bellies are trimmed off and tanned separately for shoe purposes, and only 14 square feet, or the central back portion of each hide, is used for first-class belting. This indicates one reason why good belting is expensive.

Belt Specifications

It is hard to suggest a belt specification which would be acceptable to every buyer and every seller, and there is a great divergence of opinion regarding such specifications. From my standpoint the following is reasonable in all respects:

1. The belting shall be short lap, cut from centers of the best oak-bark tanned belting butts, tanned with oak bark by the old slow and long-time process.

2. No piece of leather in the belt shall be more than 54 inches in length, including laps. The leather shall be cut lengthwise from the extreme end of the butt, eliminating shoulder, and offal of every description. No piece of leather in the belt shall be cut from a portion of the hide further away than 18 inches from the side of the backbone of the animal which shows through the center of the butt.

3. The weights shall be as follows: Single belts, 1 to 2 inches in width, 14 ounces to the square foot. Two and one-fourth to 5½ inches in width, 15 ounces to the square foot. Six inches and over in width, 16 ounces to the square foot. Double belts, 1 to 2 inches in width, 28 ounces to the square foot. Two and one-fourth to 5½ inches in width, 30 ounces to the square foot. Six inches and over in width, 32 ounces to the square foot.

The above weights are for the very best brands of heavy oak-bark tanned leather belting. Of course, belts lighter than these weights can be made and are lower in price. The quality of the leather is just as good but the substance of the belt is thinner. A second weight would be one ounce per square foot under the weights above enumerated, and for a very light-weight solid-stock belt the weights would be two ounces less per square foot than the weights above enumerated.

4. Laps. In single leather belts six inches wide or less, no laps shall exceed seven inches in length, or be less than 3½ inches in length. On all wider sizes of single belts no laps shall exceed nine inches in length or be less than five inches in length. In double leather belts, no lap shall exceed six inches in length, nor be less than 3½ inches in length.

5. Cement. All laps of leather belting shall hold securely in every part, and when pulled apart the surfaces then exposed shall show no resinous, vitreous, oily, or watery condition.

6. Tests. Belts must show an elongation of not more than 15 per cent. for single belts, and not more than 13 per cent. for double belts when subjected to a stress of 1500 pounds per square inch; the elongation to be measured under stress. The breaking strain should be about 3200 to 3500 pounds per square inch of unstressed cross-section, both single and double ply.

Belting Factors

Regarding belting factors there are many rules and regulations that are published and talked about. In Europe they use single belts for everything, whereas in America most of our belts above five or six inches in width are double ply. They carry the single-belt theory to an extreme and use single belts a meter wide. Their idea is that a single belt runs better and will transmit much more power than the same amount of leather put into a double belt; this, however, is not true because the transverse strain on a wide single belt weakens it, and a double belt over eight inches is a good investment for any service and is really necessary as a reserve power. In general they figure too close on the power-transmission proposition in Europe and the belt gets the worst of it. Some of these ideas are coming more and more into vogue here. My opinion is that the old rules that have been used for the past 40 or 50 years are the best.

Regarding the length of belts, it is generally safe to figure that the minimum distance between centers should be three and one-half times the diameter of the largest or driving pulley.

A good transmission rule, and one that leaves sufficient reserve power in the belt, is to divide the number of feet that the belt travels per minute by 800; the result is the number of horsepower that a 1-inch single belt will transmit; in other words, if a belt travels 2400 feet per minute, according to this rule a 1-inch single belt under this condition would transmit three horsepower, a 10-inch belt 30 horsepower, and so on.

A good rule for double belts is to divide the number of feet that the belt runs per minute by 500; the result is the number of horsepower that a 1-inch double belt will transmit; in other words, a double belt 1-inch wide running 2500 feet per minute will transmit 5 horsepower, and wider belts in direct proportion.

These are both old rules but they are safe.

It is impossible to give a hard and fast rule in regard to shortening a new belt before it is placed on its pulleys, and in regard to taking up belts that are in use. The factors for such shortening would vary with the different tannages of the belt leather. The old long-time process of tanning gives a long-fibered leather with more elasticity, more life and more staying power than the shorter-tanned leather. A shorter-fibered leather does not stretch as much as the longer fiber, and while it may have a greater tensile strength in the beginning it lacks the durability of the old-style long-fibered oak-bark tannages.

Thus, while it is impossible to lay down an exact rule regarding how much shorter belts should be cut than the actual tape-line measurement around the pulleys, it is safe to say that the average leather belt in the market today should be cut two inches short for each 10 feet of tape-line measurement; thus a belt that is to be 30 feet long when in place on its pulleys should be cut 6 inches short and this 6 inches stretched out of the belt when it is put in place.

By following this method a belt properly selected for the work it is to do should not have to be taken up at frequent intervals.

In regard to a factor for shortening belts in use the same conditions confront us as regards the different tannages of leather as have been mentioned above, that is, the short-fibered leather stretches less and has less elasticity and a shorter life. Two per cent. of the length should be the maximum that a belt will stretch unless it is severely overstrained. Any belt that stretches over 2 per cent. of its length is overstrained, and is liable to break if stretched to a much greater degree.

Care of Belts in Service

Regarding the care of belts in service, belts which are subjected to extreme heat or dryness need a good belt dressing applied perhaps once every six months, in some cases oftener than this, but once every six months will harm no belt if it

is properly done, and this treatment has a tendency to preserve the wearing quality of the belt.

For special service leather link belts are made for drives that have short centers, and are the only belts that we guarantee to run quarter turn; their usefulness, therefore, is limited.

Belt Efficiency

The most efficient belt can perhaps be defined as the one that will give the maximum number of horsepower hours of service per dollar of belt investment. Sometimes engineers tell us that they wish to put in a temporary drive and that they do not expect the belt to last over three months or one year, or two years, as the case may be. On the other hand, we can point to belts that have been running day after day for some 28 or 30 years and they are still in good serviceable condition. It is evident that a larger belt investment is justified in the latter case than in the former, and such cases must be decided on their individual merits.

Perhaps a short rule for the purchaser to remember in order that he may select belts that will give him the maximum number of horsepower-hours of service per dollar of investment is to design the belts with plenty of reserve capacity.

If a belt is figured according to the ordinary rule given in a previous section of this article, there is a certain amount of reserve capacity, yet it is always safe to add to this another 10 or 15 per cent. for a long-life belt. The more reserve capacity the belt has, the longer will it last and the better will it withstand sudden and severe stresses.

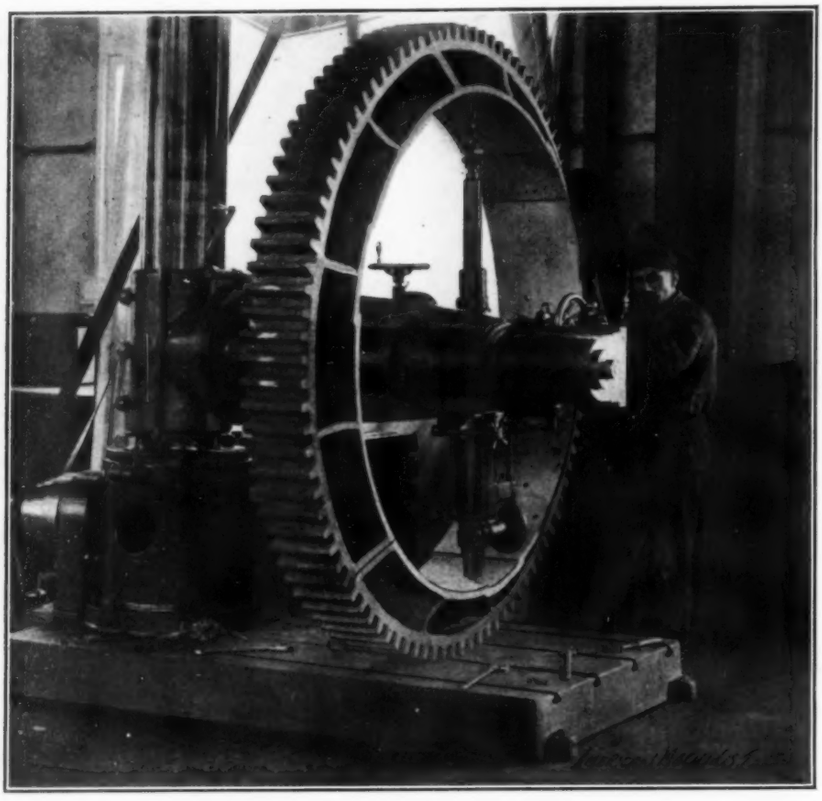
However, all of this is a question of good judgment and common sense on the part of the engineer or mechanic who is putting in the drive. It should be remembered that the first cost of the belt is not the only consideration, neither can it be entirely ignored. For greatest economy, all the considerations must balance.

Interesting Job on the Universal Radial

By D. Bell*

The halftone shows a drilling job which I thought might be of interest to readers of your paper.

The casting shown on the photograph was one of three gear rings which were made up by the Buffalo Foundry and Machine Company to be used as driving gears on cement kilns. The casting was made in one piece in the foundry from a full wooden pattern and had three splitting cores through the double-flange rim. The casting was left in the sand sufficiently long to thoroughly cool and anneal, and after being cleaned up was split at the three points. It was then drilled and the joint bolts, which are 1½ inches in diameter, were fitted through the drilled holes. The casting being split, did away with the necessity of using fitted bolts or dowel pins. The casting was then bored in a vertical boring mill to 6 feet 1 inch in diameter, the width of the bored flange being 15 inches.



An Interesting Job on the Universal Radial

It was then necessary to drill holes around the inner flange for the purpose of riveting these rings to the steel shell of the cement kiln. In doing this drilling, you will note that the casting was clamped to the base plate of a full universal radial drill. The clamps were removed before the photograph was taken. The overall length of the spindle of the radial drill with the chuck and drill was just short enough so that it would revolve inside the ring. The halftone shows the position of the spindle and arm in drilling holes in the top of the ring. The special point of interest in this job is the fact that the seventy-two 15/16-inch rivet holes through the inside ring were drilled at one setting of the casting. The weight of the casting was approximately 4000 pounds.

*Engineer, Buffalo Foundry and Machine

Rope Driving

Where the ropes bend first in one direction and then in the other, there is much more wear than when the bend is all in one direction, the former lasting about three-quarters as long as the latter.

The groove in which the rope runs should not only be carefully turned, but nicely polished, as if the fibers rub on the metal as left by the lathe tool, it will gradually injure the rope, breaking fiber by fiber and shortening the life of the rope. If the groove is too sharp the rope wedges down and puts unnecessary pressure and friction on it. Experience has led to the adoption of an angle of about 47 degrees.

The size of the pulleys greatly affects the life of the ropes, the larger the pulleys the less the fibers of the rope slide on each other and the less the internal wear of the rope. It is advisable to make the pulleys, including idlers as well as drivers, as large as practicable, but they should not be less than 40 times the diameter of the rope in any case. It is advisable that the idlers have the same shaped groove as the other pulleys, and that it be as light as possible, so that any momentary fluctuation of speed of the rope will carry the pulley with it instead of slipping the rope on the bottom of the groove by the inertia of the pulley.

A good way to harden a scriber point is to use a bunsen burner and a cup of water. Heat the point to a cherry red and dip into the water with a quick jerk.

Making Tubular Frame Micrometers

By M. E. Hoag

Micrometers that will measure 120 inches, yet are light enough to handle easily and accurately.

How they are made of thin steel, and bent to shape without wrinkling or cracking.

To the majority of mechanics the word micrometer probably conveys the idea of the ordinary 1- or 2-inch in common use, and to a few others the idea of 6- or even 12-inch instruments; but I doubt if very many have ever seen or used a micrometer that would measure 120 inches.

At first thought it may seem that an instrument of this size would be so heavy and unwieldly that it would be impossible to secure any great degree of accuracy. With the ordinary cast or drop-forged frame, such would be the case, but with the tubular-framed micrometers illustrated in this article no such trouble is experienced. The 30-inch micrometer shown at *C*, Fig. 1, weighs but a few ounces, and is so nicely balanced that the "touch" is very sensitive.

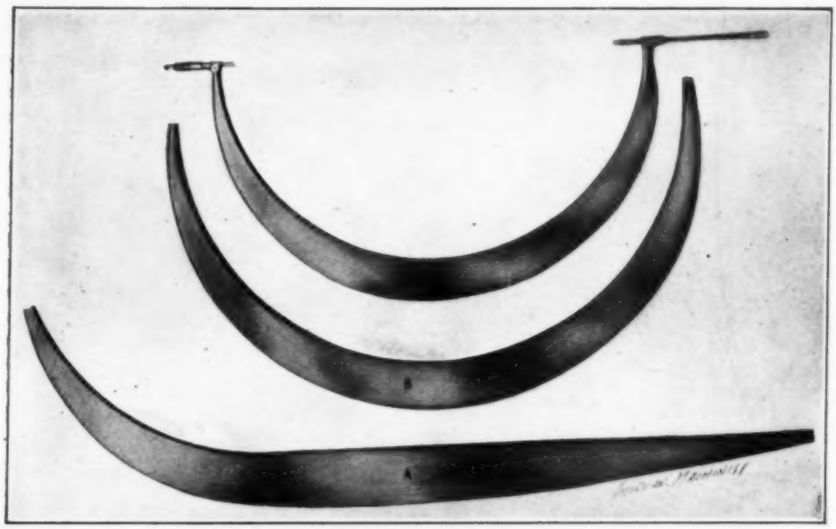


FIG. 1. THREE STAGES OF TUBULAR-FRAME MICROMETER

The frames of these instruments are made of a special grade of sheet steel, 20 gage in thickness. It is first cut to shape and folded to form a U-shaped beam, open at the back side. *A*, Fig. 1, shows one of these beams that was partly bent for the writer's special benefit. *B*, Fig. 1, is a bow bent to shape and closed in at the back. The edges of the metal being brought together over steel forms that are withdrawn as the work advances.

After closing in the frames are clamped in a special fixture and the seam brazed. The heads are next brazed in, and the instruments finished and machined for the micrometer head and anvil bar, and for the binding screws that hold them in place.

How They Are Bent

Fig. 2 shows the bending fixtures for both the bow and bar form of instruments, with partly bent frames in position. Their efficiency may be judged from the fact that these difficult bends are made without a wrinkle, and it is very seldom that a frame cracks. I was told that the U. S. Patent Office considered it impossible to make these bends in such thin metal and then close them in, and they had to be shown before considering the matter seriously.

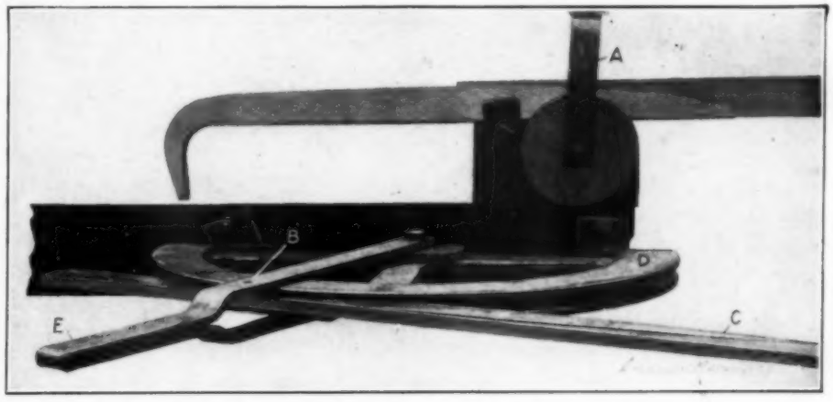


FIG. 2. BENDING FIXTURE FOR BAR AND BOW FORM OF INSTRUMENTS

The slots in these bending fixtures, or wheels, are turned to the proper diameter and radius at the bottom, and are of such a width that when the steel bar *C* is placed in a frame, the two will make a snug fit in the channel.

The bending operation is very simple: The lever *E* is pushed to the left; the frame placed in position, and a small steel block clamped into the end by a setscrew which holds the end of the frame in position. The steel bar *C* is pushed into place, and a hardened roller, not shown in the halftone, is placed in the bending lever and held by a pin at *B*. A goodly length of gas pipe is placed on the end of the lever and two men push it around the wheel. The roller at *B* forces the bar *C* against the bottom of the frame in the groove and gradually brings it to shape as it advances. The bar frames are bent in practically the same way.

These tubular micrometers are manufactured by the Davis Manufacturing Company, of Milwaukee, Wis., through whose courtesy I secured the illustrations and information.

The National Electric Light Association has adopted resolutions urging a joint commission of both houses of Congress to investigate fully the situation pertaining to the public lands of the United States in connection with the development of water powers. It is urged that this commission be composed of members of the Senate and the House of Representatives, together with persons familiar with the financial and other practical aspects of the situation, and that they hold full and complete open hearings in different sections of the country. It is urged that this commission be appointed as early as possible so that its meetings may be held between the dissolution of the present Congress and the assembling of the new Congress next fall, so that they may be enabled to take prompt action in the enactment of such laws as will permit the development of the natural resources of the country in such a manner as shall render them of the greatest possible use to all of the people.

Some Features of a Malleable Plant

Editorial Correspondence

The foundry on the top floor with its continuous pouring, shaking out and sand tempering apparatus. The traveling platform for molds with its work conveyers and chutes to tumbling barrels. A machine molders' floor and the methods of handling and riddling the sand. The annealing ovens and galvanizing room.

The Crane Company, of Chicago, Ill., who are large manufacturers of plumbers' supplies, have some novel and interesting features in their new malleable iron plant, which has but recently been placed in a systematic working condition.

The building is 177x225 feet, with five stories above ground and a basement. It is built of reinforced concrete and steel, with an outerfacing of brick, and is thoroughly fireproof. Contrary to the methods of most plants, this company starts its raw material on the top floor of the building and takes its finished products out of the ground floor.

This plan places the foundry of this new malleable plant on the top, or fifth floor, and immediately underneath it, or on the fourth floor, the castings are cleaned, sorted and annealed, and the molding and core-making sands are prepared for use. The galvanizing department is on the fifth floor.

Continuous Apparatus for Holding, Pouring and Pumping

The foundry is equipped with apparatus for continuously molding, pouring and dumping the castings. Thus the molder merely makes the molds, which, in nearly all cases, is done with a molding machine, and places them on a conveyer.

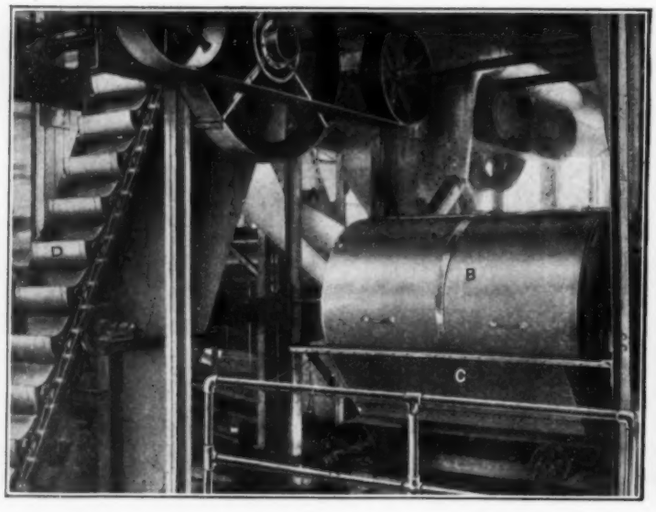


Fig. 1. Apparatus for Conveying and Tempering the Sand

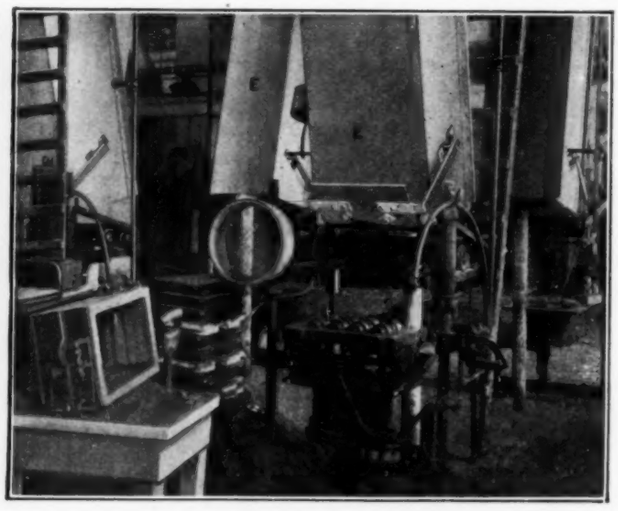


Fig. 2. A Machine Molder's Floor

In Fig. 1 is shown the method of preparing the sand for the molders. This sand comes through the chute *A*, into the mechanically operated rotary riddle *D*. From this it passes to the endless belt *C*, where it is moistened and tempered and dumped into a pocket. The conveyer buckets *D* pick it up out of this pocket and carry it to receptacles above the molder floor. From there it is dropped onto the molding machines through chutes, similar to those shown at *E E* in Fig. 1, where the molder uses it in making up the molds.

Pouring Platform

When the molder has completed a mold, he places it on a moving platform, similar to those shown in Fig. 3, and this conveys it to the place where the metal is poured in and from there to the grates on which the mold is dumped. As will be seen, the platform *F* is placed on the hangers *G*, which run on the overhead tracks *H*. The trucks from which these hangers are hung are moved by the endless belt *J* and secured to it as shown at *K*.

The platforms are all of the size shown at *F* and made to hold four molds. An iron plate *L* covers each mold. This plate is fastened to arm *M* and this in turn swings on rod *N*, which is fastened to hanger *G*. Thus, the plate can be swung back out of the way while putting the mold on the platform, and when placed on the mold it serves to hold it in position until it has been conveyed to the proper place and poured. After pouring the plate can then be swung back out of the way while the mold is being dumped.

Dumping Molds

The molds are dumped on the grate shown at *O*, so the sand will go through the floor and through the chutes, shown at *A*, Fig. 1, into the rotary riddle. Thus the sand can be used over several times during a day's run.

This leaves the castings free from sand on grate *O*, and they are then picked up by the conveyers *P P* and sent through chutes, similar to those shown at *Q Q*, Fig. 4, into tumbling barrels. These tumbling barrels are fitted with exhaust pipes that carry the dirt outside of the building.

When the castings are cleaned they are dumped in the receptacle *R*. This is fitted with wheels so it can be wheeled back under the tumbling barrels, while dumping the work. After this it is wheeled out again and lifted clear of the floors by the air hoist *S*. This air hoist runs on an overhead crane and conveys the work to the machine shop.

Chain hoists also run on a track over the tumbling barrels, for the purpose of lifting off the cover, as shown at *T*, when putting in or taking out the work. It also comes in very handy for lifting other

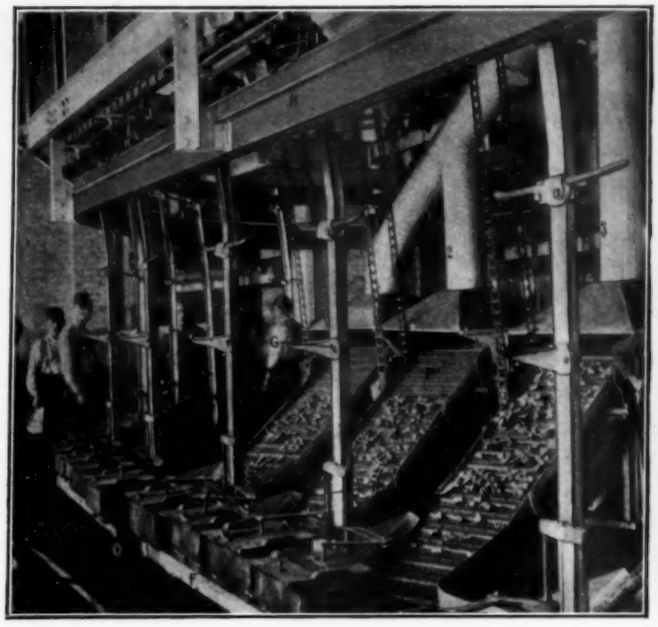


FIG. 3. OPERATION OF MOVING PLATFORMS

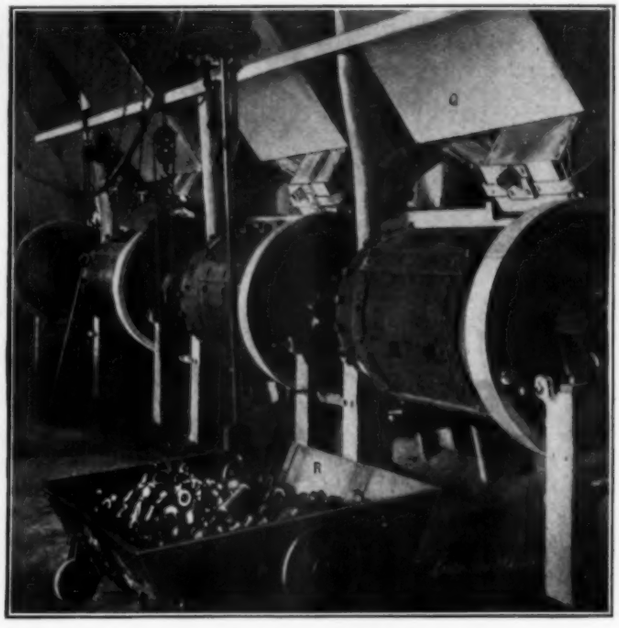


FIG. 4. EQUIPMENT OF TUMBLING BARRELS

parts of the tumbling barrels when repairing them.

ANNEALING AND GALVANIZING PROCESSES IN USE

The style of annealing ovens and pots that are used is shown in Fig. 5; a crude-oil system being installed for heating the ovens. Air hoists as shown are used to bring in the work on an overhead track and dump it into the annealing pots. After this a chain hoist is used when placing the pots in the oven, or taking them out.

An idea of the galvanizing room can be obtained from Fig. 6. The ordinary zinc process is used for galvanizing and each zinc bath is covered with a large hood to convey the fumes to the outside of the building. The usual methods prevalent throughout the plant for handling the work are used in this room as well as the others, and every effort is used to keep the work continually circulating through each department.

The core room is also supplied with modern core ovens that are equipped with endless-chain conveyers.

It will be noted that special and very effective attention has been given to the conveying and handling of materials in this plant. There are many shops, though otherwise thoroughly uptodate, in which this question is not given the study that such an important matter deserves.

The Bureau of Manufactures, of the Department of Commerce and Labor, at Washington, is establishing a file of the names of American manufacturers and traders, for use in distributing the valuable information which it receives from time to time in regard to foreign trade. Those who desire to avail themselves of the facilities thus offered for extending their trade abroad should send to the bureau their names and advise it as to the class of business in which they are engaged.

The blurred effect around the windows, known as halation, in pictures of shop interiors, is caused by the action of the light in the glass back of the sensitive film, and may be avoided by using plates having a colored film between the sensitive film and the glass and which is dissolved out in the fixing bath.

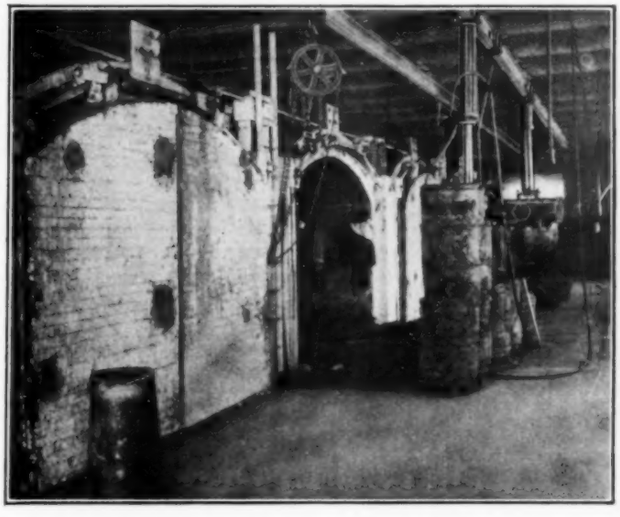


FIG. 5. ANNEALING OVENS WITH POTS AND TRAVELING HOISTS

FIG. 6. THE GALVANIZING ROOMS, SHOWING THE VENTILATION HOODS

Things To Be Learned in Every Shop

By Entropy

Every shop affords opportunity for learning many valuable lessons without loss of time. Every ambitious man can make himself more valuable if he will see what is going on and think it over carefully.

A case where a gear blank affords a course of study that cannot be found in books or schools.

There are many things which a machinist need not know in order to hold down a dollar and a half job, but which he must know if he is going to become a leading hand or gang boss.

Usually the man who gets the promotion is one who has picked up some of these things himself. They are not taught anywhere, as yet, they are not in text books or the daily papers, nor is there anyone standing around in the shop anxious to point them out.

One of these things is the order in which work should be done. For example, take a plain gear blank. There are not quite as many ways to finish such a gear as there are shops, but they are finished in as many ways as is possible. They may be chucked, reamed, put on an arbor and turned all over, a simon-pure machine-shop job that is only a trifle quicker way to make a hundred than one. The other extreme comes when it is treated as a turret-lathe job, and one face and half the width of the rim turned at one setting. Then it is turned over in the chucks and the other face and the remainder of the rim turned and the hole chucked, rebored with a stiff tool and then machine reamed.

Then there are all the intermediate ways of handling the job. The first way will give a good, true job, if the hole is reamed straight and if the arbor runs true. The last may give a true job if the machine is true and rigid and the tools are ground to cut freely. The curious part of the whole matter is that you may go about from one shop to another all day and see each shop doing the work in its own best way and yet seeing all of them do it differently.

Things to Think About

Here on this little job is food for thought for any man's spare time for a week. Think of the things to be considered. Are these gears to be keyed permanently to the shaft? Are they to go up against a shoulder, or are they running loose on a stud? If they are keyed on a shaft without any shoulder to guide them, they must be true with the bore, and if they are to run dead true they must be finished on a true mandrel. If they are held between shoulders then, possibly, all that is necessary is that the faces are parallel and the rim true when clamped up in lots on a long mandrel. Then, too, there is the question of machinery. There may be a Jones & Lamson machine or a Gisholt in the shop. That would seem to indicate that the turret-lathe method of advisable. But wait a minute. They are busy already. Will it pay to let that lot of flanged bushings go on a lathe for the sake of doing this lot of little gears. Hardly! And there you are again. Perhaps the "Old Man" will come around tomorrow and see these gears in a lathe and the Gisholt standing still. What explanation will you give? Oh, yes! the Gisholt will be running in an hour, but these gears would have tied it up five.

Take another job. Here are a lot of monkey blocks for a lathe. Will you mill them or plane them? Milling is probably quicker, but have you a cutter? Yes, but its shank is so weak that it cannot be pushed.

Then again these slides have to be scraped and your boss scraper hand says he hates the sight of a milled surface to scrape, particularly if it is an end mill. He suggests that you give them to Gus over on the 24-inch planer. You give them to Gus and he wants to know where your rigging is for stringing them along on the planer. You look a little sheepish and tell him you are planning it for the next lot, but that he will have to get along this time. Then you begin to wonder which costs the most, proper cutters for the miller or fixtures for the planer.

Overhead Costs

When Gus gets the job done and they begin to scrape the monkey blocks to the swivels you begin to find that there is a difference in planer hands and that Gus ought not to have a chance to plane anything that would not be just as good if it was left rough. Then you apologize to the bookkeeper for the scraper hand's long hours on that job, and he begins to talk to you something like this:

"Now see here, my boy, you may think that one dollar is just as good as another, but as a matter of fact it costs us more to pay a dollar to a planer hand that to a scraper hand. Just suppose that you are increasing your force and you tell us that you must either have another planer hand and the planer for him to run, or else another scraper hand.

"You say that it will cost us 30 cents an hour for each. Now, before we can set your planer hand to work we must spend at least $1000 for a planer, setting it up, belting, pulleys and small tools. That $1000 must earn us at least as much as will cover interest at the rate at which we could declare dividends, say 10 per cent., and depreciation, say 10 per cent. more, or $200 per year. Then there is the cost of power, say five horsepower, at $50 per year, $250.

"On the other hand your scraper man can be set to work on an investment of $10 or less. We will assume that each uses the same floor space, so that shop rental, etc., is the same for each. Allowing that the scraper hand will use up his equipment in a year we have a balance of $440 per year that the planer hand must earn before we can afford to pay him as much as the scraper hand.

"This very fact makes it more essential that you should not have many men like Gus, even though they may tear off a lot of metal. It costs us just as much for interest, depreciation and power for a poor as a good one. On the other hand we can afford to grade the hand workers a little closer because they cost little beside their wages."

Every man in every machine shop is seeing these things and many more decided right before his eyes every day. If he appreciates their value he can make himself valuable, if he does not, then he may expect to stand still.

An interesting paper devoted to the discussion of water filtration for industrial purposes was read by Churchill Hungerford, of Philadelphia, Penn., before a recent meeting of the Franklin Institute. The paper dealt with some of the extraordinary forms of pollution which cause trouble in certain special manufacturing processes, but in the main it discussed the problems of purification of such waters as the average textile manufacture is compelled to use. Some interesting data, relating to the relative amounts of water required by the different industries were given. A pound of muslin or similar cotton fabric requires in the bleaching process about 27 gallons of water. A pound of paper requires about 50 gallons of water and a pound of silk not less than 1000 gallons of water. The matter of the use of chemicals such as alum, lime, sulphate of iron, calcium hypochlorite, sulphate of copper, etc., as an aid to purification process was discussed, and a detailed account given of the manner in which these chemicals are completely removed from the water after they have done their duty.

Merits of Cadillac Form of Thread

By Arthur D. Elmer

The form of thread that has been adopted by the Cadillac Motor Car Co. A comparison with other forms and its advantages over them. The possibilities of making a good fit between the male and female thread and reducing the shearing strain to a minimum. Table of sizes for the different parts, with the maximum and minimum size that is allowed. Disadvantages that have been eliminated by its use and points in which it excels all other threads.

The superiority of the form of thread as shown in Fig. 1, and now known throughout the country as the "Cadillac thread," may be more plainly shown by first considering briefly other forms of threads now in use. On the male part of this Cadillac thread, the portion below the pitch diameter is in the V form and that above it is given the Franklin Institute or United States Standard form. On the female part, that portion below the pitch diameter is given the Franklin Institute or United States Standard form, and that above it the V form.

United States Standard Thread

In Fig. 2 is shown the United States Standard., Sellers or Franklin Institute form of thread. In producing this thread, if the form is adhered to in the male and female, it necessitates a fit; not only along the angle of the thread, but also on the flat, at the top and bottom.

Nothing is accomplished by having this thread fit on the flat. It is impossible to produce in practical manufacturing; and, that it has been abandoned is proved by the fact that many of the tap and diemakers have enlarged the outside diameter of their taps, while maintaining the original pitch line. This reduces the width across the flat. By abandoning the form, and by maintaining the flat its full width in the bottom of the threads in the dies, a clearance is produced at this point. No stated rule governs this, however.

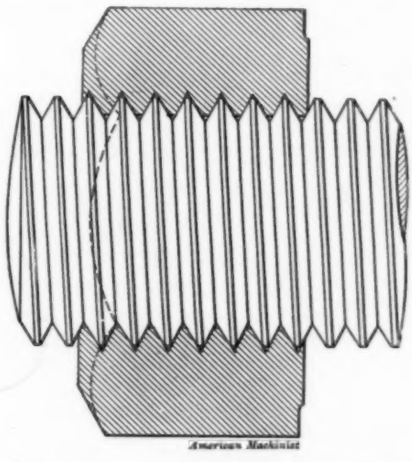


Fig. 1. Screw and Nut with Cadillac Thread

Some tap and diemakers have followed this idea with the recently adopted Association of Licensed Automobile Manufacturers' standard, so we see that this form of thread has practically been abandoned in actual practice, on account of the impossibility of its construction if adhered to, and uselessness if it could be produced.

The V Thread

Theoretically, the V form of thread, as shown in Fig. 3, is incorrect, because the tap or die will not pass through fire and water while in the process of hardening, and maintain a sharp V at the top and bottom. This is proved by an examination of the various makes of taps and dies upon the market; all of them flattening to a greater or less extent, the sharp V. This also, is not governed by any formula.

The Whitworth, Acme, International and other forms of threads are so little used in common shop practice that we will not enter upon a discussion of them.

Sizes of Taps Vary

Probably there are not two tap and diemakers in the country that produce the same size taps of any one standard.

The chaotic conditions that exist in this respect, in the V form, are too well known to need comment here, since articles have appeared in the mechanical papers at various times, showing the variation in the size of V threads as produced by different makers. This variation makes it necessary for the manufacturer using this form, to tie himself down to certain makes in order to produce similar results at different periods of time.

We believe it is a mistake to outline a theoretical proposition like the Association of Licensed Automobile Manufacturers' standard, and then leave it to the good or bad judgment or caprice of the individual, to adapt it in a manner most pleasing to himself.

This is what occurred when the Briggs standard for pipe threads was established. The Briggs standard, of course, remains today exactly as it was outlined; but note the multiplicity of interpretations. This can be readily done by buying on the market and comparing two pipe taps that are supposedly of the same size.

The same condition that exists regarding size on pipe taps is again being reproduced with this Association of Licensed Automobile Manufacturers' standard. The divergence is not as great, to be sure; but there is a divergence, nevertheless.

Allowing for Wear

You will notice that when it becomes necessary to reduce the outside diameter of V-thread taps or enlarge that of the United States Standard taps, because of the impracticability of maintaining the original form, it is done by the tap and diemaker according to his particular conception of the requirements, and not because of any stated rule outlined in the standard itself.

Take the Association of Licensed Automobile Manufacturers' standard for instance. An exact decimal measurement is supposed to be maintained where the size of the thread is stated fractionally.

One is supposed to maintain an exact outside diameter in thousandths, and it is presumed that the pitch line is figured from this, though the standard directs a reduction of the outside diameter of 0.001 inch. This is presumably done for clearance at the point of the thread.

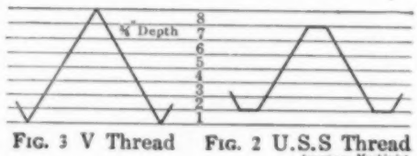


Fig. 3 V Thread Fig. 2 U.S.S Thread

American Machinist

Diagram of Thread Parts

Now, it is a fact that the tap and diemakers range all the way from producing a perfect United States Standard form, to an enlarged outside diameter as great as 0.005 inch on some sizes and they also force up the pitch line all the way from 0.002 to 0.004 inch. This is done because the tendency of the tap is to wear, and as it wears it approaches nearer the theoretical size.

The screwmakers, on the other hand,

start with their product from 0.003 to 0.005 inch small, because the wear of the dies will bring their product nearer to the theoretical size.

This enables both the tap and screw-maker to use their tools beyond the point where they should be used to produce good results, and at the same time allows them a large range of variation in size. This may be excellent for the profits of the business, but bad indeed, so far as mechanical results go.

American Society of Mechanical Engineers' Standard

In the American Society of Mechanical Engineers' standard is shown, by the engineers who established it, a realization of the absolute necessity of giving sufficient data when dealing with the problem of threads.

Limits have been established for everything, but they are so large that it is quite impossible for any firm, taking pride in its product, to use both the screws and the taps. They make what is known in shop parlance as a "sloppy fit."

The difference between the low limit of the screw and the high limit of the tap can be readily seen by a glance at the American Society of Mechanical Engineers' table of standard screw and tap sizes. There are two ways to overcome this condition and still make use of some part of the standard.

The first is: Adopt the tap chart entire. Then taps can be bought commercially. Abandon the screw sizes and establish a new table of standard sizes for them, consistent with the tap sizes. This is the manner in which the Cadillac company has overcome the difficulty.

The second method is to adopt the American Society of Mechanical Engineers' table of screw sizes, buying the screws commercially and make a new table for the tap sizes so they will be consistent with the screw sizes. The taps can then be specially made in conformity therewith.

The choice between these two methods should be determined by the relative expense involved.

In Table 1 are given the limits for the pitch diameter of standard and special screw threads, as adopted by the Cadillac Motor Car Company, and also the standard and special tap sizes as adopted by the American Society of Mechanical Engineers. These screw-thread sizes are in all cases larger than those adopted by

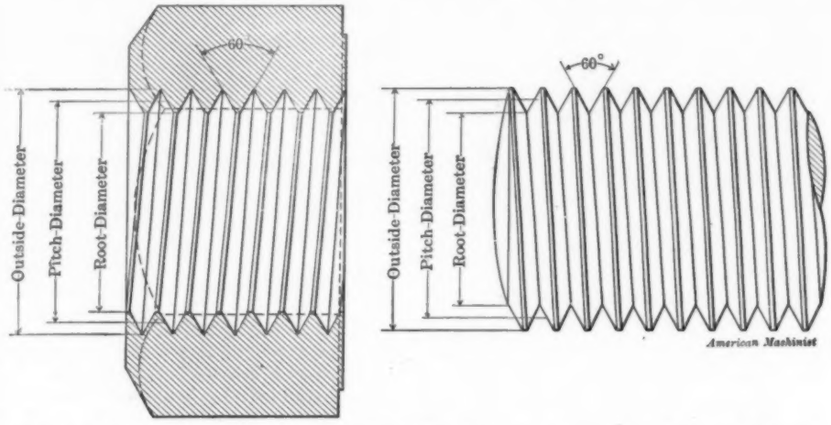


Fig. 4 The Dimensions that Must Be Correct in Male and Female Thread

STANDARD SCREWS.

Old No.	New Outside Diameter and Threads per Inch.	Pitch Diameters. Minimum.	Maximum.	Difference.	Tap Drill Number.
0	0.060–80	0.052	0.053	0.001	56
1	0.073–72	0.065	0.066	0.001	53
2	0.086–64	0.077	0.078	0.001	50
3	0.099–56	0.088	0.089	0.001	47
4	0.112–48	0.100	0.101	0.001	43
5	0.125–44	0.112	0.113	0.001	39
6	0.138–40	0.123	0.124	0.001	35
7	0.151–36	0.134	0.136	0.002	31
8	0.164–36	0.147	0.149	0.002	29
9	0.177–32	0.157	0.159	0.002	28
10	0.190–30	0.169	0.171	0.002	24
12	0.216–28	0.194	0.196	0.002	17
14	0.242–24	0.216	0.218	0.002	10
16	0.268–22	0.240	0.242	0.002	3
18	0.294–20	0.263	0.265	0.002	A or 1/4

STANDARD TAPS.

Old No.	New Outside Diameter and Threads per Inch.	Pitch Diameters. Minimum.	Maximum.	Difference.	Tap Drill Number.
0	0.060–80	0.0528	0.0538	0.0010	56
1	0.073–72	0.0650	0.0660	0.0010	53
2	0.086–64	0.0770	0.0781	0.0011	50
3	0.099–56	0.0886	0.0897	0.0011	47
4	0.112–48	0.0998	0.1010	0.0012	43
5	0.125–44	0.1116	0.1129	0.0013	39
6	0.138–40	0.1232	0.1246	0.0014	35
7	0.151–36	0.1345	0.1359	0.0014	31
8	0.164–36	0.1475	0.1489	0.0014	29
9	0.177–32	0.1583	0.1598	0.0015	28
10	0.190–30	0.1700	0.1716	0.0016	24
12	0.216–28	0.1944	0.1961	0.0017	17
14	0.242–24	0.2167	0.2184	0.0017	10
16	0.268–22	0.2403	0.2421	0.0018	3
18	0.294–20	0.2634	0.2652	0.0018	A or 1/4

SPECIAL SCREWS.

Old No.	New Outside Diameter and Threads per Inch.	Pitch Diameters. Minimum.	Maximum.	Difference.	Tap Drill Number.
1	0.073–64	0.064	0.065	0.001	53
2	0.086–56	0.075	0.076	0.001	50
3	0.099–48	0.087	0.088	0.001	46
4	0.112–40	0.097	0.098	0.001	43
4	0.112–36	0.095	0.096	0.001	44
5	0.125–40	0.110	0.111	0.001	38
5	0.125–36	0.109	0.110	0.001	39
6	0.138–36	0.122	0.123	0.001	33
6	0.138–32	0.119	0.120	0.001	34
7	0.151–32	0.131	0.133	0.002	31
7	0.151–30	0.130	0.132	0.002	31
8	0.164–32	0.144	0.146	0.002	29
8	0.164–30	0.143	0.145	0.002	29
9	0.177–30	0.156	0.158	0.002	26
9	0.177–24	0.151	0.153	0.002	28
10	0.190–32	0.170	0.172	0.002	20
10	0.190–24	0.164	0.166	0.002	23
12	0.216–24	0.190	0.192	0.002	15
14	0.242–20	0.211	0.213	0.002	8
16	0.268–20	0.237	0.239	0.002	2
18	0.294–18	0.259	0.261	0.002	D

SPECIAL TAPS.

Old No.	New Outside Diameter and Threads per Inch.	Pitch Diameters. Minimum.	Maximum.	Difference.	Tap Drill Number.
1	0.073–64	0.0640	0.0651	0.0011	53
2	0.086–56	0.0756	0.0767	0.0011	50
3	0.099–48	0.0868	0.0880	0.0012	46
4	0.112–40	0.0972	0.0986	0.0014	43
4	0.112–36	0.0955	0.0969	0.0014	44
5	0.125–40	0.1102	0.1116	0.0014	38
5	0.125–36	0.1085	0.1099	0.0014	39
6	0.138–36	0.1215	0.1229	0.0014	33
6	0.138–32	0.1193	0.1208	0.0015	34
7	0.151–32	0.1323	0.1338	0.0015	31
7	0.151–30	0.1310	0.1326	0.0016	31
8	0.164–32	0.1453	0.1468	0.0015	29
8	0.164–30	0.1440	0.1456	0.0016	29
9	0.177–30	0.1569	0.1585	0.0016	26
9	0.177–24	0.1517	0.1534	0.0017	28
10	0.190–32	0.1713	0.1728	0.0015	20
10	0.190–24	0.1647	0.1664	0.0017	23
12	0.216–24	0.1907	0.1924	0.0017	15
14	0.242–20	0.2114	0.2132	0.0018	8
16	0.268–20	0.2374	0.2392	0.0018	2
18	0.294–18	0.2598	0.2618	0.0020	D

Note—All screws smaller than 5/16 inch are to be made United States Standard form of thread in number sizes as per above chart. All taps smaller than 5/16 inch are to be made United States Standard form of thread in number sizes adopted by the American Society of Mechanical Engineers, May 29, 1907, as per above chart.

TABLE 1. CADILLAC STANDARD SCREW THREAD SIZES AND AMERICAN SOCIETY OF MECHANICAL ENGINEERS' TAP SIZES.

the American Society of Mechanical Engineers, and in some cases this difference is as much as 0.008 inch. Thus, the tendency toward a "sloppy fit' is greatly reduced, if not obliberated.

The Cadillac Thread

In discussing the superiority of the form of thread used by the Cadillac Motor Car Company, it may be well to briefly consider the difficulties to be overcome when an attempt is made to obtain a fit between a male and a female thread. Some are inherent in the problem itself; some due to the chaotic condition of the standards, as interpreted by the tap, die and screwmakers, and some to the inconsistencies, mechanical absurdities and lack of sufficient data in the standards adopted by the various associations of engineers.

To make a perfect fit between a male and female thread, there are actually ten conditions that have to be right. In Fig. 4 these are illustrated and they are:

On the male thread: 1, outside diameter; 2, pitch diameter; 3, root diameter; 4, angle of thread; 5, lead per inch.

On the female thread: 6, inside diameter; 7, pitch diameter; 8, outside diameter; 9, angle of thread; 10, lead per inch.

Nine of these conditions may be perfect and one imperfect, and the male and female will not screw together properly. For example: The male thread may be produced perfectly in all respects and the female thread may be perfect in every respect except the out side diameter which may be slightly too small. Therefore the desired result cannot be obtained. Then again; the female thread may be perfect in every respect and the male thread perfect in every respect except the root diameter, which may be slightly too large. The object is again defeated.

These illustrations might be repeated as many times as there are conditions to overcome, and a desired fit is never obtained. This applies, of course, particularly to the United States standard and "V" forms of thread.

Points of Superiority

The superiority of the Cadillac form is here illustrated very plainly, providing as it does, a clearance at the top and bottom that is governed by set rules, and which is, at the same time, great enough to allow a considerable variation without contact.

Four conditions out of the ten stated above are by this means eliminated, since the outside and root diameter of the male and the inside and outside diameter of the female are thus disposed of.

A glance at Fig. 1, which shows the assembled screw and nut, will bring out this point very clearly.

The absence of contact at the point of the thread may be obtained in a very inexpensive manner by any user of V-thread taps and dies. First ascertain the pitch diameter of the different sizes of the taps. Then establish the tap-drilling sizes to conform to the size of the V-thread taps, figured United States Standard from the pitch line to the root diameter, and also a turning size from the male threads, figured United States Standard from the pitch line to the outside diameter.

If the volume of the manufacturers' business will warrant the ordering of especially rolled stock at the mills, the exact decimal size required to obtain the desired flat on the outside of the male threads can be had, and the V dies still be used.

In an immense factory with many mechanical departments and a stupendous amount of detail to contend with, such as is involved in the building of automobiles, it is a most desirable thing to get tools that will act as detectives, so to speak, to the established turning and tap-drilling sizes. The idea being that if either are incorrect the tool will break, or the thread strip, thus calling attention to the error and insuring uniformity of product.

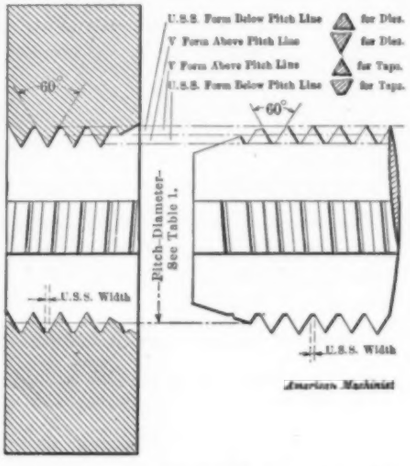


FIG. 5. SECTION OF DIE AND PART OF TAP FOR CADILLAC THREAD

Tap and Die for Cadillac Thread

To the left of Fig. 5 is shown a sectional view of the Cadillac die. Note the flat on the inside diameter of the threads. It is not intended that this flat shall do any actual cutting, but it will shear off any slight bur. However, we figure that the pitch line of this die shall be established at the high limit because it is more desirable to close it in than to expand it to obtain the desired size and also that the outside diameter, or in other words the distance across the flats, will be exactly United States Standard figured from the pitch line. The turning size of the male thread is established from 0.003 to 0.005 inch below this diameter, according to size.

In the right-hand side of Fig. 5 is shown a partial view of the tap. Note the flat in the bottom of the thread. We calculate to have the pitch diameter of this tap very close to the low limit because of the fact that the tool invariably cuts larger than itself. This is due to various causes that we will not dwell upon here. The root diameter, or diameter across the flats, on this tap is figured exactly United States Standard from the pitch

Summary

Due to the enormous shearing strength of a thread, the tap-drilling size, if desired, may be established at a ¾ depth of thread, for purposes of rapid machine tapping, as this will leave sufficient thread. If one desires more of a contact along the angles of the thread, establish the tap drilling size from 0.003 to 0.005 inch larger than the actual root diameter of the tap.

Producing a thread in the manner outlined above will enable one to forget 40 per cent. of his thread troubles. We still have with us the angle of the thread, lead per inch and pitch diameter.

The 60-degree angle of the thread is not at all difficult to obtain and the thread micrometer makes the determination of the pitch line easy. The change which takes place in the lead during the process of hardening seems to be the most difficult point to overcome. A great deal of work is being done along this line, however, and we may soon hope to arrive at some method whereby this part of the problem will be readily solved. Another advantage that is derived from this form of thread is the possibility of making

Diameter and Threads per Inch.	Tap Drill.	Turning Size.	Pitch Diameter.	Limit on Pitch Diameter.	Limit on Root Diameter of Taps.	Limit on Outside Diameter of Taps.	Limit on Shank Diameter of Taps.	Limit on Square of Taps.	Limit on Outside Diameter of Threads in Dies.	Limit on Inside Diameter of Threads in Dies.
C ⅜–18	J	0.307–0.309	0.275	0.275–0.277	0.239–0.241	0.318–0.320	0.313–0.315	0.238–0.240	0.311–0.313	0.232–0.234
C ⅜–20	F	0.308–0.310	0.279	0.279–0.281	0.247–0.249	0.317–0.319	0.313–0.315	0.238–0.240	0.311–0.313	0.241–0.243
C ⅜–24	11/64	0.311–0.313	0.287	0.287–0 289	0.260–0.262	0.318–0.320	0.313–0.315	0.238–0.240	0.314–0.316	0.256–0.258
C ⅜–27	11/64	0.306–0.308	0.285	0.285–0.287	0.261–0.263	0.312–0.314	0.313–0.315	0.238–0.240	0.309–0.311	0.258–0.260
C ⅜–32	J	0.308–0.310	0.291	0.291–0.293	0.271–0.273	0.313–0.315	0.313–0.315	0.238–0.240	0.311–0.313	0.269–0.271

TABLE 2. SIZE LIMITS FOR ⅜-INCH DIAMETER OF THREADS.

cheap and practical test tools, a subject which may be dealt with at some future time.

Concluding, it may be said that this combination of the V and the United States Standard form which gives the clearance at the points of the thread carries with it positive rules by which to arrive at all dimensions and makes it possible to obtain an easy running or wrench fit as may be desired. This is well illustrated by Table 2.

A French Cylinder Reaming Machine

By Edmond Leymarie

A vertical, four-spindle cylinder-reaming machine. Spindles are adjustable, with reference to each other and in stroke. It is also adapted for general reaming work within its capacity.

Of all operations necessary in making automobile-motor cylinders, reaming is certainly the most delicate and it is very hard to get a perfect result, especially when using multiple cylinders which are now commonly adopted.

Some automobile builders employ special fixtures adapted to ordinary machine tools; or, again, multiple-spindle machines, such as are well known in the industry. But most of these fixtures are very expensive and can be used only for cylinders whose bores to be reamed are at constant distances. Consequently it has been necessary to change the fixture as often as a new motor is adopted.

In view of the great variety of types employed in the automobile industry, there have been made series of complicated fixtures, which often can be used only for machining a number of pieces quite insufficient to cover the price of these costly appliances.

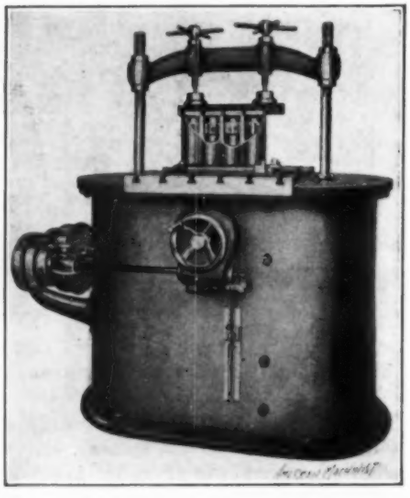


FIG. 1. FRENCH FOUR-SPINDLE CYLINDER-REAMING MACHINE

Messrs. Lubin & Weiffenbach, machine constructors at Clichy, near Paris, have seen fit to devise a special machine that will perform all the reaming operations required in ordinary practice with precision and rapidity.

By utilizing the four spindles, one may at pleasure ream four simple cylinders or two double cylinders or the quadruple cylinders, called "Monoblocs," which are today in use. An ingenious device allows adjustment of distances of the four spindles from 60 millimeters to 140 millimeters (2.4 inches to 5.6 inches), with a vertical movement of 300 millimeters (12 inches).

The control of this machine is entirely automatic, requires no experienced workman, and permits its operator to run several of them at once.

DESCRIPTION OF THE MACHINE

This machine is composed of a hollow frame *A* (see the illustration), oval in form, against the lower part of which slides a carriage *B*, on which are the spindle holders. These spindle holders *C* are composed of cast-iron sockets externally rectangular and bored at each end with central holes in which are adjustable split bearings, conical in form, to take up the play. The spindles *D*, of cast steel, trued, turn in these bearings and carry at the top end cutter holders *F* with adjustable blades. On the lower end of each spindle is a gear. The tool pressure is taken up by ball bearings placed on the spindles. The four gear wheels engage in pairs with worms at the right or left of the spindles. This arrangement allows, by placing the gears of the spindles in a square, of bringing the axes of the spindles close together, while preserving a sufficient diameter for the gears.

The lower part *G* of the spindle carriage, supports the two worms, and forms an oil reservoir. Worms and gears consequently turn in a bath of oil, which saves them from wear.

The machine is driven by a three-step cone pulley *H*, which actuates one of the screws through a vertical shaft *I* and bevel gears. The second screw is driven by the first through two spur gears. The spindle carriage is fed by a vertical screw *J*, which passes through a nut *K*, fixed to the carriage. This screw is driven by a horizontal shaft *L*, through two bevel gears. The horizontal shaft

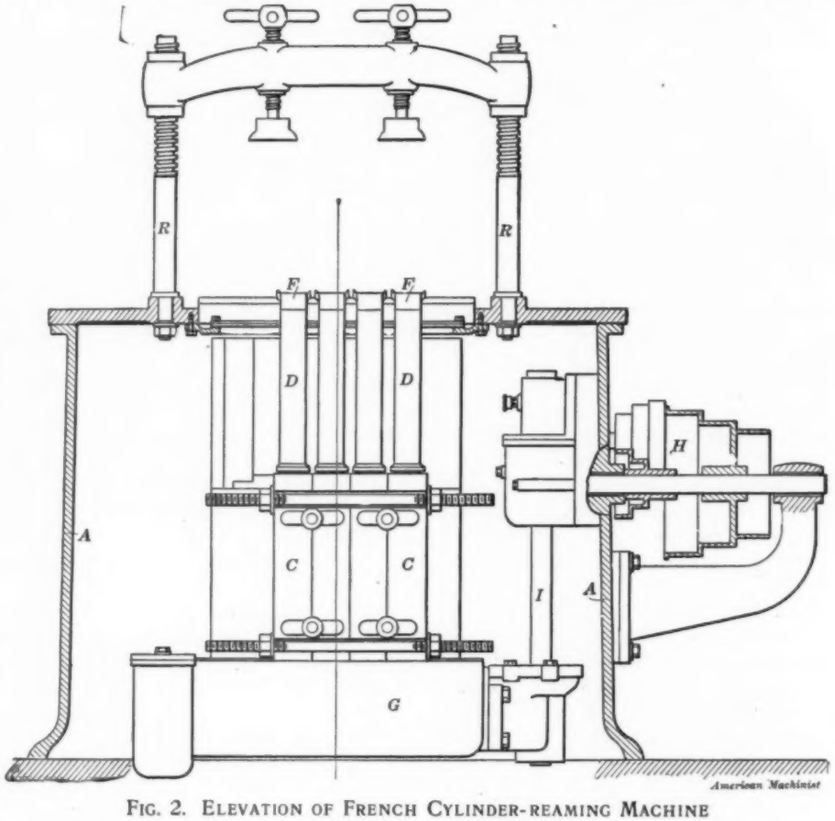


FIG. 2. ELEVATION OF FRENCH CYLINDER-REAMING MACHINE

carries the hand wheel *M*, driven by a gear engaging with a worm keyed on a hollow horizontal shaft *N*. At the end of this hollow shaft is the feed-driving cone pulley *O*, which gives three rates of feed.

A rod passing through the hollow shaft transmits to a friction *P*, placed on the side of the cone, the motion from an adjustable stop. This arrangement forms an automatic disconnecting device. The four spindle holders are clamped together and fixed on the carriage by strong bolts. They constitute, therefore, a single, very rigid block. The distance of these spindles is adjusted by placing between them keys of appropriate thicknesses. Finally, the top of the frame forms a table *Q*, with T-slots for mounting the work. It carries further two columns *R*, intended to hold, if required, a support in cases where the spindle passes through the cylinder; or in the case of a closed cylinder, the clamps for holding it in place.

The spindles being well guided are designed to avoid all flexure. All the moving mechanical parts are inclosed in casings, forming a reservoir for oil. The doors on the frame allow ready access to the mechanism. The chips are carried outside of the machinery by a slide fixed on the table, which further excludes from the mechanism dust and foreign bodies. By reason of the vertical arrangement of the machine the chips are removed rapidly, whereby heating of the cylinders is avoided, as also the scratches which chips sometimes produce.

The auxiliary tool equipment needed for machining cylinders is almost nothing, because of the variable spacing of the spindles. The mounting and dismounting of the cylinders is performed very rapidly and easily

There can be reamed a "Monobloc" of four cylinders with 75 millimeters (3 inches) bore, and 200 millimeters (8 inches) depth, in two operations (roughing and finishing) in 30 minutes.

This machine is built in two sizes known as Type No. 1 and Type No. 2. In the former the minimum distance between spindles is 70 millimeters (2.8 inches) and in the latter 110 millimeters (4.4 inches). Similarly the maximum distance between the axes of the spindles is 140 millimeters (5.6 inches) and 187 millimeters (7.48 inches), respectively. The maximum spindle stroke for the smaller machine is 290 millimeters (11.6 inches); for the larger 370 millimeters (14.8 inches).

These machines are, of course, adapted for reaming work of any kind and are by no means restricted to the cylinder class of work covered in this article.

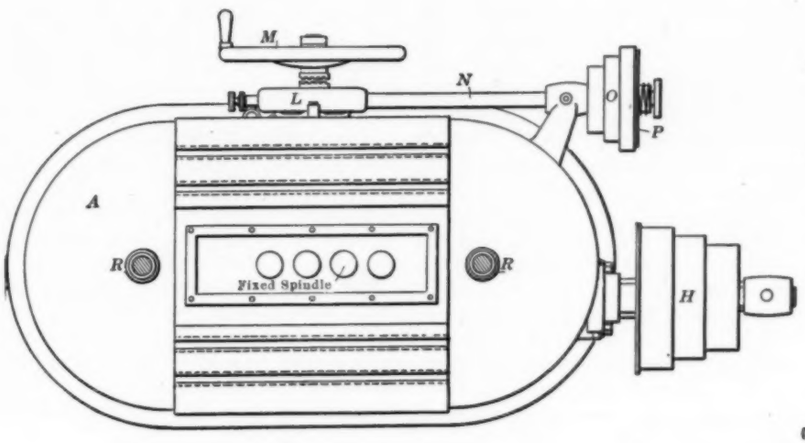


FIG. 3. PLAN AND SECTION OF FRENCH CYLINDER-REAMING MACHINE

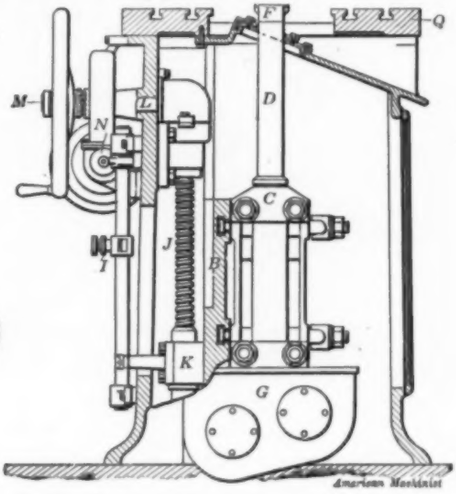


FIG. 4.

Holding Hardened Gears for Grinding

Automobile manufacturers and others who, owing to the severe duty imposed upon the gears used, are obliged to harden or heat treat them, have difficulties all their own, owing to the almost uncontrollable tendency of steel to go out of shape more or less during the heating and cooling process.

Some hold the gear by the outside, which is probably as good as any place, *if the outside of the gear blank was perfectly true* when the teeth were cut. If it was not, holding it by the outside does not hold it true with the pitch line of the gear, and if the hole is ground in this condition, the pitch line is eccentric with the shaft on which the gear runs.

HOLDING BY THE PITCH LINE

To avoid this, many hold the gears by rounded jaws or by round steel pins as near the pitch line as possible. While this is probably the correct point to hold them, from theoretical considerations alone, it presents a number of difficulties which sometimes amount to more than one might suppose.

If a gear is distorted to any extent so that it becomes of oval form, as is often the tendency, it becomes necessary to adjust more than one of the locating pins, or jaws, instead of simply moving one of the three as would suffice had the pitch line remained a true circle.

Any variation in the pitch diameter at a particular point multiplies the distance which the locating pin at that point must be moved in order to bear on both teeth on account of the flatness of the curve at that particular point. A comparatively slight variation in the width of the tooth space at the pitch line, for example, will allow the pin to move many times the amount of this variation in the width, owing to the flatness of the tooth curve.

HOLDING BY THE BOTTOM OF THE SPACE

In view of the difficulties of both the outside and the pitch-line method, it would seem much better and simpler in every way to abandon both of these and hold the gears by the *bottom* of the tooth space. When gears are cut with a rotary cutter, the bottom of the tooth space is bound to be equally distant from the center of the arbor on which it was held while being cut, so that holding it from this point would be fully as accurate as working from the pitch line whether it was distorted or not.

This same condition would prevail with a hobber and with the Fellows gear shaper method unless it should happen that the generating cutter had a long or a short tooth, which is hardly likely to be the case.

Chucking the gears by the bottom of the tooth space seems to be fully as easy as any other method, and allows us to disregard any slight eccentricity of the outside of the gear. This has no bearing in the matter unless the eccentricity is more than the clearance so that the point of the long tooth comes in contact with the bottom of the tooth space in the opposite gear, which very seldom turns out to be the case.

Estimates for Building Motors

By F. C. Mason

An answer to the problem presented by Frank C. Hudson, containing many definite suggestions as to the tools required and the probable time necessary.

In answer to Frank C. Hudson's problem, would say that the author is not actively engaged in the motor or auto industry, but as an interested party suggests the following.

Rate 25 per Month

Tools required: 16- or 18-inch swing lathe; 20-inch drill press, internal grinding head with ½-horsepower motor, planer or milling machine. The lathe should be a heavy type, such as a geared-head lathe of a well known make. The large Landis internal head is very suitable for lathe use; to be driven by a motor.

The special tools required would be: Jigs for drilling stud holes; taps; tap and reamers for valve openings and seats; master plate for locating cylinder on face plate.

Mr. Hudson does not state the accuracy required in these cylinders, except the 0.001 limit in grinding.

Machining Cylinders

There is much controversy as regards machining cylinders. Some finish the bore at one setting; some rough bore and lay away to season; others rough bore and anneal before final finish. For the ordinary commercial work I think the former process is correct. For the highest grade the late process is probably better.

As I assume the problem involved is commercial, we will base our operations on that.

First operation: Chuck cylinder, rough face the base. Bore with two cuts, allowing 0.005 to 0.007 inch for grinding. Finish facing its base and grind cylinder to size. Time for boring and facing about 1½ hours; grinding, 1 hour.

Second operation: Drill holes in cylinder base, as the further operations are located from these. Time, 10 minutes.

Third operation: Mill or plane bosses for water-intake and exhaust pipes. If done on a planer, as many as the table would accommodate could be put on and all three bosses finished at one setting. If eight were put on at once, which a small planer would easily accommodate, these would average one hour each. They should be held on a master plate, each cylinder being located by the stud holes in the base.

If finished on the milling machine of the universal type, it would take somewhat longer, as you would have to shift cylinder, making two settings as well as changing the cutter; slab mills for the top and end mills for the side bosses. The ideal way for this operation would be a three-spindle miller, all spindles using end mills.

Fourth operation, valve ports: The cylinder should be held on a master plate attached to the face plate of lathe. This plate should be pivoted on the face plate, the pivot being central with the cylinder bore and having a movement equal to the chord of the valve centers, 2¼ inches. The pivot should be located from the lathe-spindle center, the same distance as from the valve center to the center of the cylinder bore.

This distance is the hypotenuse of 3 5/16 inches as the base and 1⅛ inches as altitude. The movement of this plate should be regulated by two permanent stops to locate the valve openings correctly.

Bore valve opening to proper size and rough turn valve seat. Have a steel bushing that will fit into this opening to guide the drill properly for the valve-stem holes. After drilling, ream. Your valve seater should have a guide stem fitting this hole after finishing valve seat. Tap opening for closing cap. Time, 40 minutes each.

Fifth operation, drill and tap remaining holes: These holes may be laid out accurately by using a surface plate and all measurements taken from a given point, these points being registered from the four holes in the cylinder base. Time, one hour, a total time of five hours each.

Building 25 per Week

In this case I would have the jigs and tools as refined as possible, having one jig only for drilling and tapping all holes at one setting of the cylinder in the jig; this to be done after boring the cylinder. By having these small tools correctly designed we could reduce the total time to four hours.

Making 25 per Day

The first operation is boring the cylinders. Being a single-unit cylinder I would advocate boring on a Gisholt or Pond Rigid turret lathe, this lathe to be fitted with the following special tools: Box chuck to locate cylinders accurately and in the least amount of time; two chucking reamers or boring tools, one for rough boring, the other for finishing ;one turret facing tool for finishing the base.

Sequence of operations: Chucking cylinder, 3 minutes; rough boring, leaving 0.020 inch for finish, 8 minutes. While rough boring, also rough face cylinder base with tool from cross slide. Finish boring, allowing 0.007 inch for grinding, time, four minutes; finish facing, 3 minutes; taking out of chuck, 2 minutes; total, 20 minutes, allowing for incidental delays and securing 25 per day of 10 hours.

Second operation, milling: Would do the milling on a miller of the Newton type, having three spindles of suitable size, which would be determined by the other jobs in connection with the motor, as we assume that you build the engine complete.

These bosses can be faced off at from three to five inches per minute. The cylinders to be located by special fixtures registering from the cylinder bore. This milling operation should not average over five minutes per cylinder.

Third operation, drilling and tapping: These should be done at one setting of the jig, jig to have slip bushings to be easily taken out after the drilling operation so as to accommodate the tap. I would advise using two drill presses, two jigs and two operators.

The first operator would set the cylinder and drill all holes; the second operator would do the tapping, using a Geometric or Errington tapping head. Drilling machine to use Grönkvist drill or other quick-change chuck for rapid changing of drills.

Fourth operation, finishing valve seats, etc.: I would also use two drill presses here, an all-geared machine for the drilling and a suitable machine for the tapping, the first operator to do all drilling, using a four-lip chucking drill of proper size for the threaded cap with auxiliary counterbore for seat.

Change the bushing in jig to guide drill accurately for valve-stem bushing; then drill and ream. Change bush for valve-seat rougher. Seat valve with finish cutter, both of these valve-seat tools to have pilots that fit reamed hole for valve-stem bush.

All tools for this machine fitted to hand slip interchangeable holder. The operator then passes jig to the tapping machine for tapping for the caps. As the tapping operation would be quicker than the drill and reamer, this operator can attend to loading and unloading the jigs. Time for both operations, four cylinders per hour.

Fifth grinding: Use a Heald cylinder grinder. Never having used one of these machines I cannot say as to the output, but judging by other known grinding operations the one machine should easily take care of 25 per day.

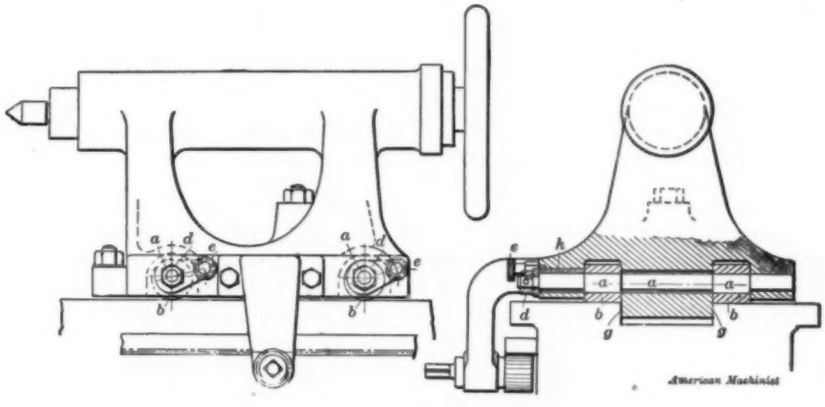
The designs of these tools are all of simple character, and I think with the description given, any toolmaker of ordinary ability could produce them.

Letters from Practical Men

Concerning the details of making things in machine shops, from the first sketch to the shipping room. A letter good enough to print will be paid for. The value is in the idea—not the length of the letter

Arrangement for Easy Movement of Large Tailstocks

When moving a large tailstock along the bed a great deal of time, energy and power is needed. Figs. 1 and 2 show an arrangement for making this motion easier. Two eccentric shafts *a* are passed through the base of the headstock; on these shafts four rollers *b* are placed, two on each shaft. When it is required to move the tailstock along the bed, a wrench is used for turning the hexagons *d*. This turns the eccentric shafts *a* and lifts the tailstock just clear of the surface of the bed, so that it rests on the four rollers *b*. They are then locked in this position by pushing the pins *e* into holes in the base. The tailstock can then be either pushed or racked along.



EASY MOVEMENT OF LARGE TAILSTOCKS

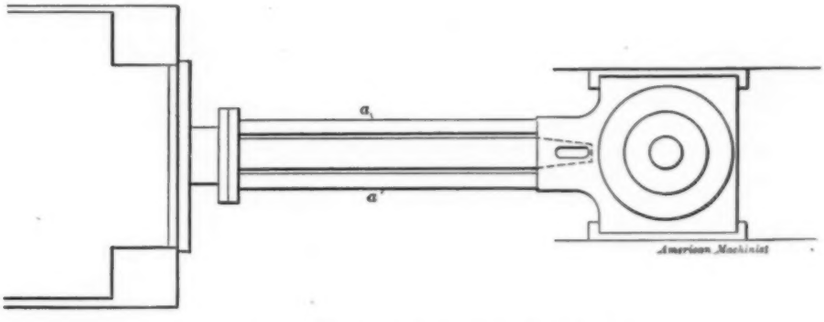
Manchester, England. W. R. OAKES.

Removing a Crosshead from a Piston Rod

Some years ago a 500-horsepower Corliss engine was to be dismantled and it was found impossible to remove the crosshead from the piston rod by any of the customary methods. The end of the rod was a taper fit in the head, as indicated in the sketch.

After several schemes were tried and abandoned we decided to utilize the principle of expansion and contraction of metals under the action of heat and cold, and arranged as follows to get the head off that rod:

In the sketch the rod and crosshead are shown with the rod projecting its maximum distance from the cylinder, which gave a measurement between the end of the crosshead and the face of the stuffing box of about 6 feet. A gasolene torch was applied near the middle of the length of the rod, where a sheet-steel hood had been arranged, and, although various observers said it would be impossible for us to heat the rod sufficiently in this way to cause it to expand appreciably, nevertheless, after application of the heat for some little time, the length of the rod had increased as much as was required for our purposes.



REMOVING A CROSSHEAD FROM A PISTON ROD

In the machine shop a pair of steel shafts had been squared off slightly longer than it was supposed they would be required, and after the rod was heated a measurement was taken between the face of the gland (which was backed up against the stuffing box after the packing was removed) and the inner end of the crosshead. This measurement was telephoned over to the machine shop, and the shafts were then carefully squared to a length slightly less than the measured distance. The two shafts were then brought over to the engine room and placed as at *a a*, at the opposite side of the piston rod, between the ends of the crosshead and the stuffing box, where they were supported upon a simple frame. Cold water was then poured upon the hot piston rod and the instant it commenced to shrink it pulled the crosshead snug against the ends of the shafts and in a moment the crosshead was forced free.

Springfield, Ohio. R. C. MITCHELL.

Value of the Advertising Pages

I always search through the advertisements, to keep in touch with anything new which might be applied advantageously to the work over which I have supervision.

For a long time we had been after a tool to be used by the erecting men on a certain operation. Nothing advertised seemed to quite fill the bill, and tools made in the shop had only been more or less successful.

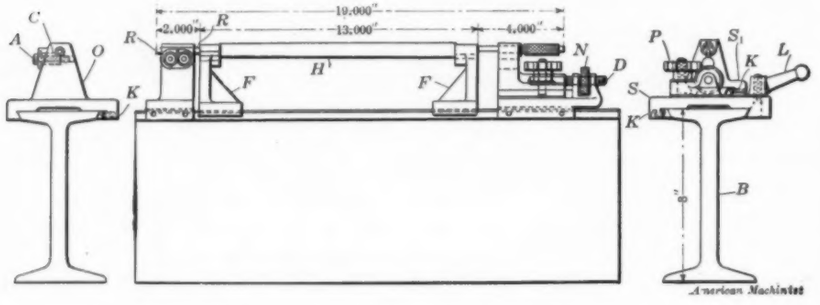
In looking over the advertisements recently, I was interested in the cut of another tool, to do other work; but, the general method of operation suggested an idea which, applied to the tools formerly used in the shop, increased their efficiency about 100 per cent.

Chicago, Ill. B. J.

An Inexpensive Measuring Machine

The accompanying illustration is of a measuring machine for measuring or testing inside and outside caliper gages to keep them up to standard dimensions. This scheme is in actual use in a large shop where gages of large size are used. It was set up on the bench, but can be adapted to stand on a plate leveled on the floor.

At *B* is a standard 8-inch I-beam with both top and bottom flanges machined. The rounded portion of the top flange was machined off at 30 degrees to allow for the sliding of the different parts of the machine. Any length beam can be used, in this case an 8-foot beam was necessary. The machine rested on the bench in the tool room, and the tool keeper used it in keeping the calipers, inside or outside, and pin gages to the standard size. The tool keeper also had charge of the master gages used in setting up the machine prior to measuring or testing a gage.



AN INEXPENSIVE MEASURING MACHINE

The slide *S* sliding on the I-beam, has an upper slide as S_1, which moved on *S*. As the minimum measuring capacity was 2 inches, and the maximum was 8 feet, this slide was placed at the distance needed. The lower slide, or *S*, was at first approximately located and clamped by means of *L*. For adjustment afterward the upper slide, or S_1, was adjusted by turning the nut *N*, operating the screw *D*, attached to S_1. The binding screw is readily seen on the drawing. The slide S_1 was held in a similar manner by the nut *P*, operating a screw which was pulled against the under side of the dovetail.

The slide *O*, which remained stationary, contained two spindles *R*, which contained the minimum capacity of the machines. When the ends were worn enough to appreciate, the screw *A* was loosened, thereby allowing the spindle *R* to be moved, and when they were reset the screw *A* was again tightened. The ends of the spindles are slabbed slightly to allow for the application of a small wrench. The screw *R* forces a bushing at *C* against spindles *R*, thereby maintaining their position.

Master gages *H*, already referred to as being kept in the tool room, were made in lengths ranging from 12 inches to 24 inches. Of the 24-inch length there were four. These master gages rested on supports *F*, which held up each end, while if used other than on the ends of the machine they supported the ends of gages resting midway of the support *F*, allowing *F* to support two master gages at once.

The slide *S* contained a micrometer head, graduated in ten-thousandths of an inch, where the final reading of each gage tested was made. Naturally when inside gages were to be tested, master gages *H* had to be removed. By introducing a master gage upon the supports, say 13 inches long, the machine could be used for testing outside gages of 19-inches capacity. By removing the master gage the original set-up is suitable for a 13-inch inside gage.

Set screws at *K* were for compensating for the wear of the slides upon the I-beam.

This machine, although simply and cheaply constructed, is of great benefit to the inspector.

JOHN W. WEBBER.

Swampscott, Mass.

Stretching Connecting Rods

We had several connecting rods made according to the upper view shown in the accompanying line cut. They had a thread on one end and a ½-inch round boss on the other, and were finished all over.

When we came to assemble the machine we found them ⅛ inch too short and did not have time to make new ones. Therefore we decided to stretch them.

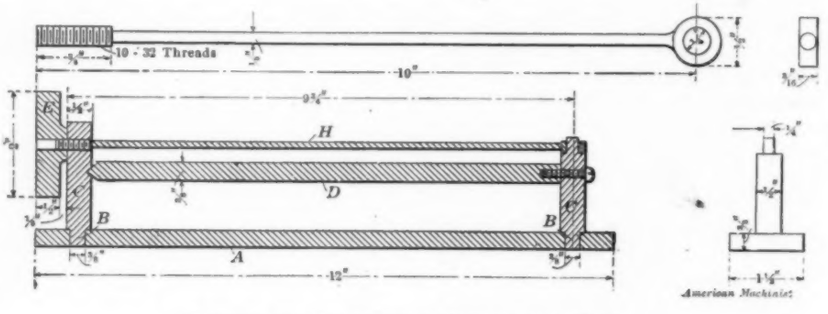
One was heated and then carefully hammered until it expanded to the required length. This, however, left the piece with hammer marks all over and it looked bad. We therefore used the method here shown to stretch them.

In making the fixture we took a piece of ⅜x1½-inch cold-rolled steel 12 inches long for base *A* and drilled two ¾-inch holes in it, as shown at *B B*. We then took two ½-inch round pieces *C C* and turned one end down to fit the ⅜-inch holes in base *A*. One of these was turned on the opposite end to fit the ¼-inch hole in the connecting rod, while in the other was drilled a hole to receive the threaded end of the rod.

Pieces *C C* were then driven into place and a ⅜-inch round piece *D* fitted between them for a brace, as shown, and next piece *E* was turned and drilled and tapped to fit the threaded end of the rod.

By putting the rod in this fixture, in the position shown at *H*, and heating it with a gas torch until it became red, it could be stretched the desired ⅛ inch by taking four turns with nut *E*, as the thread was 32 per inch. After polishing with emery cloth the rods were then all right.

Chicago, Ill. F. E. A.



FIXTURE FOR STRETCHING CONNECTING RODS

A Few Shop Suggestions

Long jobs can be bored in the lathe to good advantage if a bronze bushing is fitted to the lathe spindle, and one end of boring bar resting on dead center is fed through. The tailstock may be left loose and fed by means of a clamp, attaching it to the carriage. Work is held in the chuck or on the face plate. Facing cutters can be used if desired.

Wrenches for Armstrong boring bars should be so relieved that they touch at base of tool only. The point is not injured then.

Cap and set screws on jigs which are used a great deal, should be a loose fit and the heads should be slotted for a large screwdriver, which should be chained to jig.

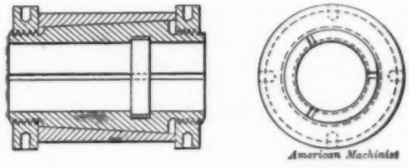
Piston pins that wear equally on all sides can be made by placing brass caps on ends of pin before same is placed in cylinder. Wear takes place in piston, rod and on pin. Brass tips will not score the cylinder.

Stillwater, Minn. V. JACKSON.

A Steady Rest Spider for Nurled Work

We had a lot of nurled rollers 8 ft. long by 2 inches diameter to turn on the ends to ⅞ inch diameter by 12 inches long. Owing to the great length and small diameter there was considerable chatter. To overcome this we made the "spider" or bushing thrown in the line cut to slip over the work and run in the steady rest.

The inside bushing has a 2-inch hole in it and is split in three parts. The outside bushing closes the inside one on the



A STEADY REST SPIDER FOR NURLED WORK

work and is held in place by the nuts on the ends. The recess in the inside bushing is to accommodate a light spring. This spider gave good satisfaction and is in constant use.

Pearl River, N. Y. J. R.

Tapping Device for Drill Press

We had a great many holes that required tapping but they were too large to be tapped with any rapidity on the available sensitive drill presses. I therefore, tried to secure a tapping device that would run slow enough, and have sufficient power to drive a ⅝-20 tap. Such a device was not to be found in the market, so I designed the device shown in the accompanying line-cut.

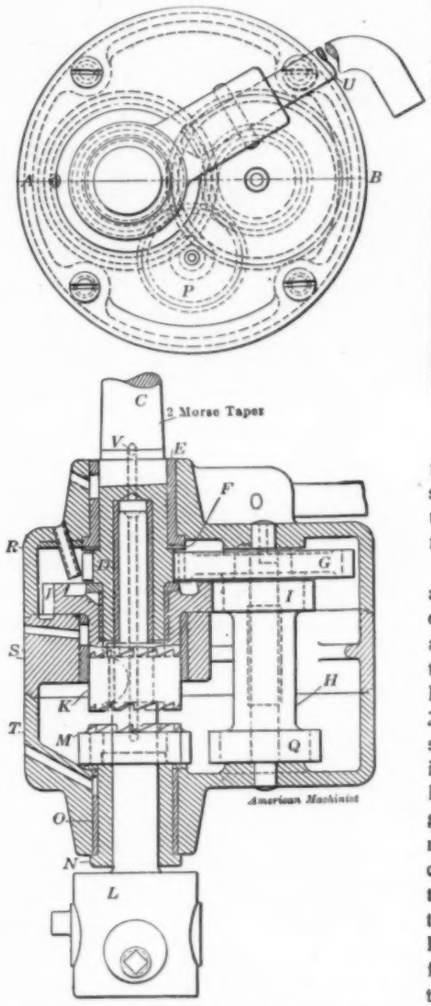
The lower view is a sectional elevation taken on line *A B* of the upper view. Shank *C* is made with an integral gear *D*, below the bearing *E*, and thrust washer *F*. This meshes with gear *G* which is keyed to piece *H* by the three ⅛-inch dowels.

The 16-tooth gear *I*, at the top of piece *H*, meshes with the 30-tooth gear *J*. This gear *J* has clutch teeth cut in the end of the hub, which engage piece *K* and drive chuck *L* clockwise.

The tap is reversed by raising the spindle until piece *K* engages the clutch teeth cut in the hub of gear *M*. Sleeve *N* is fastened to *M* in order to give the gear a large bearing surface in the hardened bushing *O*. Gear *M* is driven through the intermediate gear *P* shown in the upper view and this meshes with the gear *Q* at the lower end of piece *H*.

It thus requires 1⅞ revolutions of shank *C* to make chuck *L* revolve once when backing out the tap and for tapping, the shank makes 3½ revolutions for every one revolution of the chuck. With this reduction the spindle of the drill press can be run with the driving belt on the intermediate, or high speed without any slipping of the belt.

In order to assemble the parts it is



LOW-SPEED TAPPING DEVICE FOR SENSITIVE DRILL PRESSES

necessary to make the casting for the case in three parts, as shown by *R*, *S* and *T*. The ⅜-inch machine-steel handle *U* is for holding the case from revolving.

All the bearings are provided with ample lubrication. The bearing at the upper end of the chuck *L* is oiled through a 3/32-inch hole *V* in shank *C*. The surplus oil passes through this hole and out at the top of bearing *N*. The recess in the top of gear *J* is undercut, in case the oil is applied when the fixture is running, the centrifugal force will not throw all the oil off at its periphery and what is left in the recess will run into the bearing when the fixture is stopped. Intermediate gear *P* is oiled through the brass tube which is flush with the top of part *R*.

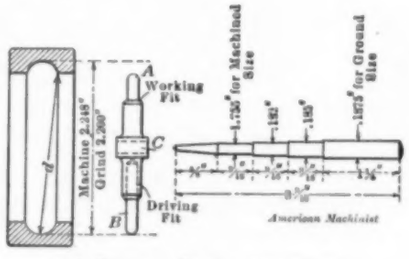
The stud *W*, which is the bearing for piece *H*, is held from revolving in castings *R* and *T* of the case by a 1/16-inch dowel pin.

Detroit, Mich. R. P. SMITH.

A Special Ball-Race Gage

In the accompanying engraving I show a special inside gage which was made to use on some sample ball bearings.

As the sketch shows, the drawing of the bearings called for a ground diameter of 2.260 inches, which size had to be just about right in order to give a smooth



A SPECIAL BALL-RACE GAGE

running bearing. It was found that a standard inside micrometer could not be used, and therefore the gage was hurriedly made.

A piece of ½-inch rod was chucked and drilled as shown. A 5/32-inch piece of drill-rod *B* cut to proper length, stoned and polished on one end and driven in; the other piece *A* was made a little too long and then filed and stoned down to 2.260 inches with the gaging-pin in position at its largest diameter (0.1875 inch). The length over all must be a little less than *D*. If 3/16 inch will not give enough travel for *A* the gaging pin must be made of larger wire. The shoulders between the different diameters on the gaging-pin should not be sharp, but taper as they naturally will from the tool. Holes *A* and *C* should be reamed and afford a nice working fit for their respective parts.

Chicago, Ill. ARTHUR F. KUNZE.

Hard Spots in Autogenous Welds

One of the undesirable results from the use of autogenous welding methods, such as oxyacetylene are hard spots which cannot be machined with ordinary tools. It is easy to lay the blame upon the welding process, but it can be largely avoided. It is true that the heat of the acetylene process, as high as 4200 degrees Fahrenheit, is more likely to produce hard and burned spots than that of

the 3400 degrees Fahrenheit oxyhydrogen flame. Nevertheless, by suitable manipulation of the welding, it is very generally possible to avoid such hard and burned places.

In the welding, four points are to be considered: (1) The weld should be made only with the point of the inner flame cone about 5/16 inch long. (2) Thick pieces are to be previously heated by any method. (3) This flame cone must be sharply defined (perceptible through smoked eyeglasses); the feed of oxygen must be kept to a minimum. (4) As soon as a weld has been made, the flame must be moved along. Since we often see a thick piece of work "daubed over," so to speak, with an inadequate flame containing too much oxygen, it is not surprising that burned places occur.

The gist of the matter is, therefore, to make good soft welds by doing the work in the right way. If there still is found, once in a while, a hard place, we should, if feasible, remove the thin hard crust with a carborundum file. However, in most cases, this is not to be done. Then we may adopt the plan of sprinkling on the spot some commercial soapstone (a sodium hydrate). The area in question should then be brought to a red heat and allowed to cool slowly. The sodium hydrate melts and exerts a decomposing or fluxing effect in the hard crust. When cool, the scale of sodium hydrate and iron that has formed on the surface may be knocked off with a hammer, after which the metal can be easily machined with ordinary tools.

By this method, the stresses produced by autogenous welding may be relieved which also, in many cases, can be done by annealing.

P. EYDAM.

Charlottenburg, Germany.

A Difficult Error to Locate in a Gage

A toolmaker, grinding a notched gage, as shown in Fig. 1, found that the jaws were not parallel, being the widest at the top. Mentioning the fact to a young fellow workman, who was not a toolmaker, they got into an argument. The young man, Mr. Wilbur, being, by the way, an Artisan School boy, thought he could see why it was, but not having the gift of argument, appealed to me.

What the toolmaker was doing was holding the piece in a vise, business edge up, and passing an emery wheel, as shown in Fig. 2, through, first grinding one jaw with one side of the wheel and the other side by the other. The emery wheel was recessed as shown and the edges *A* and *B* narrower than the undercuts *C* and *C* of the gage. The toolmaker was using that part of the wheel from *D* to *E*, Fig. 3, to grind one jaw and the other side from *F* to *G* to grind the other jaw, while Wilbur claimed that if he would use the same part of the wheel for both sides, that is, from *F* to *G*, the jaws would be parallel; but he could not bring the toolmaker to his way of thinking and at this stage of the game he turned the question up to me, and it seemed at first I was as stupid as the toolmaker. Finally after going over the case one way and another, he said, "You could grind an ellipse, couldn't you?" and that at once solved the problem.

Evidently the shaft of the emery wheel was not absolutely at right angles with the slide of the grinder, and this may have been the reason why the toolmaker only used one part of the wheel, as, when it reached the center, it would not cut if he passed it through. Looking at the problem, as shown, exaggerated in Fig. 4, it will be seen that looking at the wheel edgewise when set skewed it shows a thin elipse. If one jaw is ground with the part of the wheel from *D* to *E* and the other jaw from that part of the wheel from *G* to *F* the two jaws would from necessity be the farthest apart at the top, but if ground by that part from *F* to *H* they would be equal distance apart all the way up and down, though theoretically each with a minutely curved surface and neither absolutely square with the bottom. In the case in hand, these defects would be so minute as not to be appreciable.

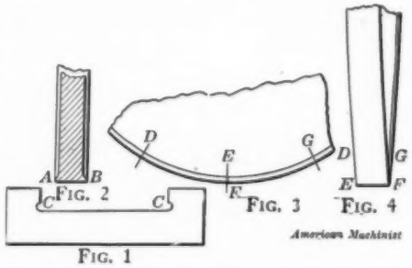


FIG. 2 FIG. 3 FIG. 4

American Machinist

FIG. 1

A DIFFICULT ERROR TO LOCATE

Syracuse, N. Y. JOHN E. SWEET.

Notes on Fixture Cams

The ideal cam undoubtedly is the one that will never rattle loose, and requires the least movement in order to bind.

We find in Kent's handbook, under friction, that the angle of repose in friction of motion (angle α in Fig. 1) is 4 to 4½ degrees for smooth surfaces occasionally greased, and 3 degrees for smooth surfaces continuously greased.

As an example; to find the rise per 9 degrees of circumference of a cam having the diameter *d*, Fig. 2, we proceed as follows: Lay down the circumference of the cam, Fig. 2, as in Fig. 3; circumference $= \pi d$. The angle of repose is 3 to 4½ degrees and *y* is the rise on the whole circumference; that is, 360 degrees.

$$y = \pi d \times \textit{tan.}\ 3 \text{ to } 4\tfrac{1}{2}\ \textit{degrees},$$

and for 9 degrees the rise would be

$$x = \frac{9}{360}\,y = \frac{1}{40}\,y.$$

Tan. 3 to 4½ degrees = 0.05241 to 0.0787; as an average, say 0.0655. Then,

$$x = \frac{\pi d \times 0.0655}{40} = d \times 0.00514.$$

The result is that the rise per 9 degrees,

$$x = 0.005\,d.$$

Here we have a short and correct formula, easy to remember, and doing away with all guesswork. Taking, for example, a cam of 2 inches diameter, the rise per 9 degrees would be $2 \times 0.005 = 0.01$ inch, and for 3 inches diameter, $3 \times 0.005 = 0.015$ inch, and so on.

In a cam constructed according to the above formula, there will be safety combined with the least movement. Another important point to be remembered is that the weight of the handle always should help to tighten the cam; as shown in Fig. 4, arrow *a* gives the direction in which the cam binds. If the handle had been arranged as shown in Fig. 5, its weight always would tend to loosen the cam. In such a case, a little chattering of the fixture would be enough, especially with a comparatively big handle, to loosen the piece being machined and so, possibly, causing the whole device to be destroyed.

Fig. 6 shows a special face plate for

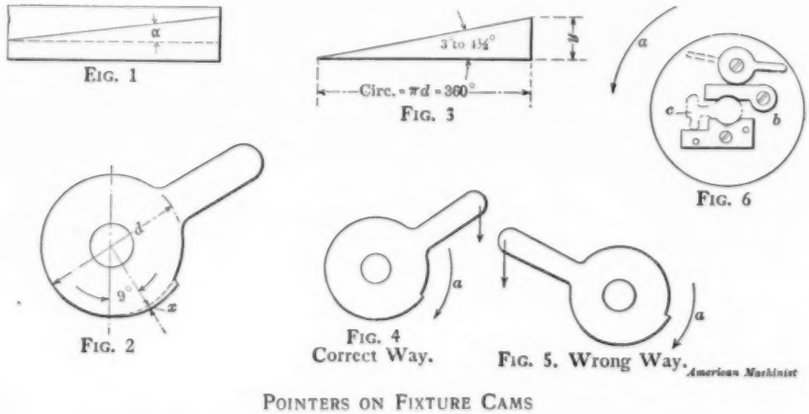


FIG. 1 FIG. 3 FIG. 6

FIG. 2

FIG. 4
Correct Way.

FIG. 5. Wrong Way.

American Machinist

POINTERS ON FIXTURE CAMS

use on a lathe, on which it was necessary to clamp the piece with a cam, as shown. The face plate revolved in the direction of the arrow *a*, at a high speed. That way, the centrifugal force keeps on tightening the cam; whereas, had the latter been arranged as per dotted lines, there would be a dangerous tendency of opening the clamp *b*, allowing the piece to come flying out and hit somebody, break the tool, or otherwise do a lot of damage.

Hartford, Conn. J. C. P. BODE.

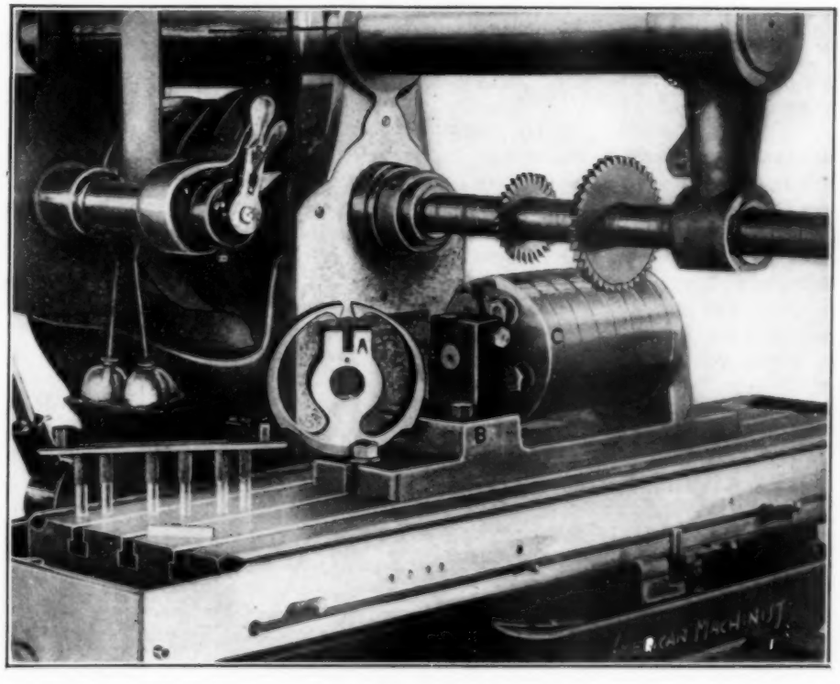
Jig for Milling Clutches for the Landis Grinder

The cut shows a jig for milling the slot and angles in the clutch disks as seen at *A*.

The angle piece *B* and head *C* being removable indicates how the work is placed in the jig. The pins and straight-edge seen on the left are for alining the work, six pieces of which are chucked at one time. Into a ⅝-inch reamed hole (and through which the central slot is cut), in each of the clutches, is placed a pin. The straight-edge is now placed in position, the lugs on it fitting into notches in the heads. The work is now revolved until the pins rest against the straight-edge, after which the nuts on the long studs are tightened, clamping the work and heads firmly. The holes being set in a vertical position, the central slot is now milled with the large cutter, after this is accomplished the index pin is removed and the clamping nut loosened and the work revolved through 17½ degrees (this being the angle of the work). The index pin is again inserted, the table moved to proper position and the angles milled with the small cutter, provision being made to revolve work in both directions for the two angles.

ULRICH STEINER.

Waynesboro, Penn.



JIG FOR MILLING CLUTCHES

An Unusual Drilling Job

Over at the power house they were putting in two new boilers of 300-horse-power capacity. The last connection to be made, to complete the piping from each boiler to the main steam pipe, or "log," was through a section of 8-inch pipe about 12 feet long. As the flanges to which the pipe was to be bolted were at an angle of about 70 degrees with each other, and one flange was 4 feet higher than the other, the pipe, of necessity, contained a "double-compound" bend, which had been executed at the boiler shop; and accurately, too.

UNUSUAL DRILLING JOB

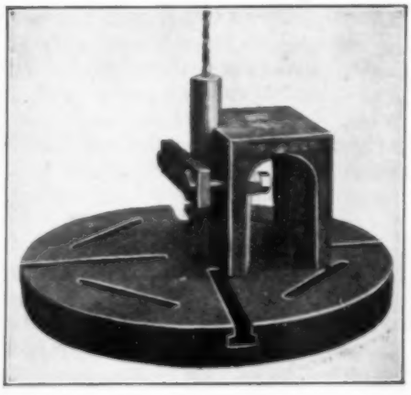
Now, the interesting things about these two pipes were the flanges, which were of steel, welded on, and left blank to be marked from flanges already erected, and drilled in the field. The superintendent had set a man and a ratchet at work on each end of one of the pipes and at the end of the first day had a hole and a half drilled in each flange, which was not surprising, for a 1-inch hole 2 inches deep is quite a stiff proposition for a springy old man. Next morning he 'phoned to the shop for help and I went to look the job over. I told him to bring those pipes to the shop and he could have one in a day's time. This was done and they were drilled in the lathe, as shown in the half-tone.

We removed tailstock and cross slide, and bolted to the carriage two parallels having T-slots in them. On the parallels we put a pair of V-blocks, and in them laid the ends of the pipe, which was straight for about 30 inches. The drill was put in the chuck and the end strain taken off the clamping bolts by a knee bolted to the forward parallel. Power feed was employed; but, the rod feed not being powerful enough, the thread-cutting screw was used, it being geared up to give 1/100 inch to one revolution of the drill. After each hole was drilled, the pipe had to be loosened and revolved, in which operation the portable crane was very handy; for, though drilling was a short job, " hossing" the unwieldy thing about was no small task.

Middletown, N. Y. SILAS F. CRONK.

Angle Plate for the Tool Room Drill Press

This tool needs no lengthy description; the cut showing it in use on the drill will clearly illustrate its advantages; all sides and edges are either at right angles or parallel to one another, which permits work to be drilled from five positions at one chucking; i.e., the two ends, the side on which the clamp is and the two sides at 90 degrees to this last position.

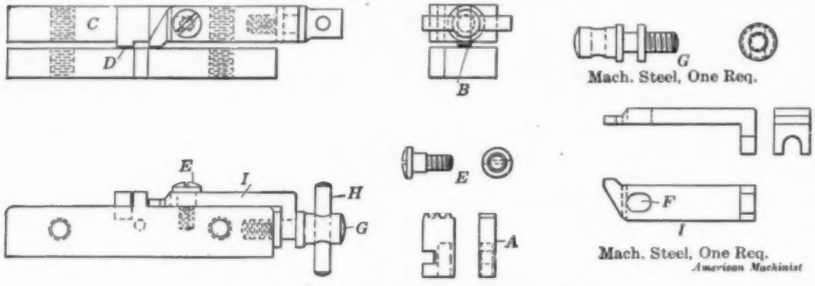


TOOL-ROOM ANGLE PLATE

Waynesboro, Penn. H. H. E.

A Pair of Vise Jaws for the Miller

The vise jaws illustrated herewith are worthy of note in that they are provided with an extra clamp working sideways, above that provided by the lateral movement of the moving jaws. They are for form milling the teeth on the top of the piece *A*. The piece is placed in the jaws



A Pair of Vise Jaws for the Miller

resting on the pin *B* in the movable jaw *C*, and against the lug *D*, which is an integral part of *C*. When the jaws are closed, the piece is clamped between them and also by the clamp *I*. The travel of this clamp is limited by the screw *E*, working in the slot *F*, and it is caused to bear by turning the adjusting screw *G*, by the handle *H*.

This pair of jaws and many others of the same type are in use in one of the largest typewriter factories in the country and have been found to give just as good satisfaction as more expensive fixtures.

Philadelphia, Penn. J. H. Harris.

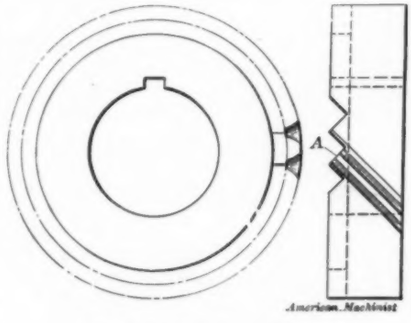
A Milling Machine Problem

I came across a little problem in the shop the other day, and I am going to turn it over to the readers of the American Machinist. The workman was making a circular hob for generating a 12-tooth spiral gear in a special machine, and he was following the usual method of making a formed cutter and then milling the teeth in the hob. There was nothing difficult about this, but there was some trouble experienced in getting the correct form of tooth in the hob.

The idea struck me that it might be generated by a hob of the same form as the spiral gear itself, and it would be possible under these conditions to secure an absolutely correct form of tooth. The next question was: Could it be done in a Brown & Sharpe, No. 1½ universal miller? I am going to leave the solution to the readers, and I think it will make some of the old heads sit up and take notice.

The hob was in reality a spiral gear, as shown in the illustration, and not a hob, as that term usually implies. The necessary data are here given: Hob, O. D., 1.9958 inches; P. D., 1.891 inches; angle, 45 degrees; thickness, ½ inch; number of teeth, 32 R. H.; teeth cut out with 90-degree cutter after forming to give proper cutting face, *A*, Fig. 1; work, O. D., 0.7812 inch; number of teeth, 12; angle, 45 degrees; depth of cut, 0.094 inch; cutter No. 3, 24 pitch, R. H.; feeds on the No. 1½ Brown & Sharpe miller are 3, 4, 5, 6, 7, 9, 11, 14, 17, 20, 23, 27, 32, 39, 50, 67, 82, 100, 120 and 150 thousandths per revolution of the spindle, and the gears available were 100, 86, 72, 64, 56, 48, 44, 40, 32, 28, 24 and 24; lead screw is ¼ inch pitch.

As a further hint, I will say that a vertical milling attachment was also avail-



The Spiral-gear Hob

able, and there would be no objection to making any extra gears necessary to obtain the proper leads; or a spindle might be made for the dividing head, to take a gear and thus drive it direct instead of through the worm. The angle of the hob might also be given a little leeway; anything between 45 and 44 degrees. But the pitch diameter must be held to 1.891 inches, and it would not be advisable to use a very heavy feed, as the hob was to be made of mushet steel.

Beloit, Wis. H. M.

A File Holder for Flat Work

Frequently I have heard the name "German planer" applied to a large file. The tool or handle shown, when clamped to a large file, comes very close to being a planer when it is required to remove stock from a flat surface. For metal a long file is used, for patterns I use a 14- or 16-inch file, cutting off and squaring the tang end and cutting (grinding) the file through the middle, thus making two short files; handy for the purpose for which they are intended.

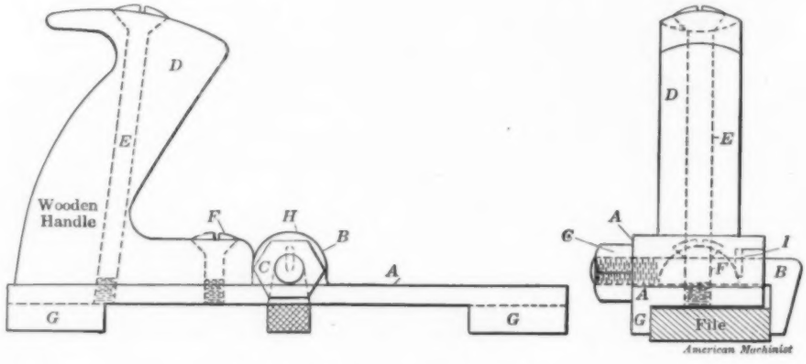
A is a machine-steel piece with jaws *G* and *G* and hub *H* through which a ¼-inch hole is drilled and reamed to receive the shank end of the jaw *B*.

B is tool steel, threaded for a case-hardened nut *C*, and having the inner face of the jaw toothed. *I* is a position pin secured in the shank of the jaw *B*. To allow a lateral motion for jaw *B* in boss *H*, a slot or keyway is cut to fit the pin *I*. *D* is a wooden handle, such as is used on carpenter's planes, ¼-inch holes are drilled for bolts *E* and *F*, these are secured in drilled and tapped holes, as shown.

A section is shown clamped in position.

Kenosha, Wis. J. H. R.

It is again pointed out, this time by a contemporary in the motor-cycle field, that finely powdered or deflocculated graphite introduced in the oil tank in the proportion of a teaspoonful to a quart of oil will make the engine run more smoothly and hold its compression better. The graphite will not interfere with the action of any mechanical lubricator. It also is good for grinding valves, making the operation easy and giving a fine polish to the seats.



A File Holder for Flat Work

Issued Weekly by the
Hill Publishing Company
JOHN A. HILL, Pres. and Treas. ROB'T MCKEAN, Sec'y.
505 Pearl Street, New York.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Subscribers can have address changed at will. Give old and new addresses.

Subscription price $4 per year, postage prepaid, to any post office in United States, United States possessions and Mexico. $5.50 to Canada. $7 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

Hill Publishing Co., Ltd., 6 Bouverie St., London, E.C., will serve all subscriptions for English Edition for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

Published in the German language under the name of "Maschinenbau," by the Hill Publishing Co., m. b. H., 71 Unter den Linden, Berlin, N. W. 7. Price for Germany 24 M., Austria 29 K., Switzerland 32 Fr., other countries in Eastern Hemisphere 35 M., North or South America 40 M., or $10.

Entered at New York Post Office as mail matter of the second class.
Cable Address, "MACHINIST," N. Y.

CIRCULATION STATEMENT

During 1910, 1,488,400 *copies. For January,* 1911 *(American weekly, American monthly, English weekly and German weekly), total,* 124,250.

February 2..... 40,750

None sent free regularly, no returns from news companies, no back numbers.

Contents

PAGE

New Features in Boring Machines..... 191
Efficiency of Shop Training in Schools.. 194
Total Keyway Depth..... 195
Microscope in the Hardening Room..... 196
Planer Jigs, Gages and Other Tools..... 199
Nonadjustable Cast Iron Bearings..... 203
Making, Use and Care of Belting..... 204
Making Tubular Frame Micrometers..... 207
Some Features of a Malleable Plant.... 208
Things to Be Learned in Every Shop... 210
Merits of Cadillac Form of Thread..... 211
A French Cylinder Reaming Machine... 214
Estimates for Building Motors..... 216
Letters from Practical Men:
Arrangement for Easy Movement of Large Tailstock....Removing a Crosshead from a Piston Rod....Inexpensive Measuring Machine.... Steady Rest Spider for Nurled Work .... Tapping Device .... Ball Race Gage....Difficult Error to Locate in a Gage....Notes on Fixture Cams ....Jig for Milling Clutches....Unusual Drilling Job....Milling Machine Problem.....217-222
Analysis of Four Boring Mill Drives.... 223
Application of Oxyacetylene Torch..... 225
The Strenuous Task of the Inventor.... 226
Coöperation of Machine Shop and Pattern Shop..... 226
Savings Bank Insurance..... 227
New Tools and Machine Shop Appliances 229

American Machinist

The Strenuous Task of the Inventor

The interesting account given by Mr. Westinghouse, in his presidental address before the American Society of Mechanical Engineers, of the invention and development of the air brake, presents several distinct phases of interest, neither of which is entirely new, yet none of them of trivial import. His narrative illustrates and emphasizes the fact that no great invention is completed and brought to enduring success except as the result not only of alert ingenuity but also of persevering industry.

Too many visionary mortals are dominated by the belief that sudden and isolated happy thoughts bring fortunes to inventors, and many rush to the patent office with crude ideas hastily put into some semblance of practical shape, expecting that when a patent issues a fortune will follow in a very short time. Patent agents and periodicals of a certain class encourage the idea, but the felicitous result expected is never realized. If anyone, say, forty-five years ago, which would have been just before Mr. Westinghouse began, had been suddenly struck with the thought that compressed air could be applied to the braking of trains, and had secured a broad patent upon his "invention," as doubtless he might have done at that time, he might have been none the richer, and railroads might have been no safer nor more reliably handled. In the coming of the great world-dominating inventions there may be an instant of birth, but there must also be a long period of nursing and feeding and growth before maturity.

The isolated thought of the air-actuated brake would have been at the best but a beginning and far enough from a successful consummation. Mr. Westinghouse began even farther back than that. He set out with the general purpose to devise reliable means for the braking of trains, and his first devices were of the general class already made sufficiently familiar by the attempts of others. When his alertly searching mind caught the compressed-air idea, he had his life work before him yet to be done, instead of its being then completed. His first successful air brake, which certainly would apply the pressure and stop the train, was still a failure rather than a success, because in case of accident when it was most needed, as in the breaking in two of a train, it became by the fact absolutely inert and useless. We might expect the "happy thought" inventor of the single device to abandon the scheme at this point, as many similarly situated have done, but the untiring inventive inertia of Mr. Westinghouse carried him forward to complete success, so that the brake ultimately satisfied all conditions. All that anyone then could ask for or think of was provided by the automatic air brake with the ingenious novelty of the triple valve, but this was later followed by the quick-acting automatic brake and the emergency features, called for by the heavy trains and the high speeds which the earlier brake developments had made possible and permissible.

Mr. Westinghouse in his address scarcely suggested the scope of the demands of the air-brake idea or the reach of invention entailed in the satisfying of them. He made no allusion to his compressor or air-brake pump, which was in itself a striking embodiment of many novel ingenuities. It has provoked various criticisms, but practically all of its peculiarities have been vindicated by long service in the satisfying of special and exacting conditions.

All along, while the development of the invention proper was progressing, the standardizing of parts and the securing of interchangeability were constantly studied and brought nearer to perfection, in which work he, of course, secured the aid of the skill of others as supplementary to his own. Indeed, as he tells it, everything and everybody all the way through seem to have worked together for his success and there is scarcely a hint of difficulties or of opposing conditions, which, however, must have been met with more or less along the way, but which were forgotten as they were successively passed. Besides the determining of all the details of the invention itself, the faculty of so exhibiting and advertising it as to make the railroad world rush for it with all eagerness was the one thing which has been conspicuous by its absence in the makeup of many inventors who have had apparently every other equipment for success.

Cooperation of Machine Shop and Pattern Shop

There should be more coöperation between the machine shop and the pattern shop.

It has long been recognized that cooperation of the molder and patternmaker is necessary, but it is often overlooked that there is much to be gained by closer relations between the machine shop and the pattern shop.

Too often there is an excessive amount of "finish" provided on a pattern, and in

consequence the machine work is greater than necessary. Frequently cores are provided which increase the cost in the foundry and do not decrease the work in the machine shop. Very often work of machining, which the cores are intended to obviate, can be done in one-half the time which is required in the foundry for the core work. It is sometimes the case that the cores do not reduce the machine work, but rather increase it, causing loss in both the foundry and machine shop.

In one large establishment, the losses due to causes similar to these, were studied and it was found that they were much larger than expected. In fact, they were so large, that radical steps were taken to eliminate them.

All standard patterns were sent to the machine shop, one at a time, to be studied and criticized. Instructions were given that no changes should be made without reference to the superintendent unless the foremen of the machine shop, foundry and pattern shop agreed that they were desirable. Many changes were made, and only in a few cases was it necessary for the superintendent to give a decision on account of failure of the foreman to agree. Many of the improvements were so evident that the patternmaker and molder had no grounds on which to disagree.

In that establishment every new pattern now goes to the foundry via the machine shop, and is subjected to a critical examination from the machine-shop point of view. Within a few months the machine shop found little to criticize, for the patternmaker had learned to study the work required both in foundry and machine shop, and provided a pattern which reduced the combined cost of the foundry and machine-shop work to the minimum.

Savings Bank Insurance

From time to time we have called attention through these columns to the trial being made in the State of Massachusetts of issuing wage-earners' life insurance through savings banks. Statements have just reached us, showing the transactions of the two banks which are issuing this insurance for the financial year ended Oct. 31, 1910. We do not need to go into the details of these statements, other than to say that they are very favorable. The dividend announcement is equally favorable and deserves mention.

Both banks will distribute dividends to their policy holders on the following basis: On monthly policies issued during the year ended Oct. 31, 1908, reaching their third anniversary during the coming year, a dividend of 1⅔ times the monthly premium will be paid. In addition thereto half of one monthly premium as an adjustment of a dividend received last year by these policy holders on the first year's scale.

On policies issued during the year ended October 31, 1909, reaching their second anniversary in the current financial year, the dividend will be 1½ times the monthly premium.

On policies issued during the financial year just closed the dividend will be one monthly premium, payable on the anniversary during the current year.

On deferred annuity policies 30 per cent. of one monthly premium on their anniversary during the current year. In addition thereto, 30 per cent. of one monthly premium on policies issued in the financial year ended October 31, 1909, which received no dividend during the last year.

On the annual premium policies the dividends cannot be expressed as a percentage of the premiums, but the amounts are in keeping with the amounts indicated above.

This is indeed a commendable showing, and we again urge public-spirited men in other States to consider this field of service and take steps to start similar life-insurance movements for the benefit of the wage earners in their own States.

New Publications

ENGINEERING THERMODYNAMICS. By C. S. Hirshfeld. 157 3½x6-inch pages; 22 illustrations in the text. D. Van Nostrand Company, New York City. Price, 50 cents, net.

This second edition of Professor Hirshfeld's little book has been revised and corrected. In a brief space it gives statement of the fundamental laws upon which the superstructure of thermodynamics stands. It is sufficiently extensive to give a working knowledge suitable for most engineering purposes and enables anyone so inclined to follow the more generalized and complicated problems considered in more extensive works.

A PRACTICAL COURSE IN MECHANICAL DRAWING. By William F. Willard. Published by the Popular Mechanics Company, Chicago. 134 pages. 129 illustrations. Price, 50 cents.

This book gives a comprehensive course in drawing in very concentrated form. Starting with the simplest principles, it takes in geometrical constructions, the application of the principles of working drawings, the development of irregular surfaces for pattern work, the principles of descriptive geometry for determining the lines of intersection of solid figures, and finally the principles of isometric drawing. A chapter is also devoted to simple free-hand lettering. In giving examples for the student, illustrations in isometric are given, which are to be drawn in ordinary projection to make working drawings, with dimensions. All of the principles are profusely illustrated.

Personals*

Horace A. Brown, Jr., has accepted a position as sales engineer in the automobile department, eastern district, of the Hyatt Roller Bearing Company.

William L. Mahon, sales engineer with the Taylor Iron and Steel Company, has resigned to accept a position with the Titan Steel Casting Company, of Newark, N. J.

W. E. Linsday, formerly conducting a consulting engineer's practice, has become secretary and treasurer of the American Welding Company, Carbondale,, Penn.

Edgar Ard, conducting an engineering practice at Starkville, Miss., has been appointed professor of mechanical engineering in the Mississippi Agricultural and Mining College.

Frederick R. Hutton, honorary secretary of the American Society of Mechanical Engineers, has been appointed consulting engineer to the water commissioner of New York City.

S. F. G. Knox, formerly vice-president and chief engineer of the Bucyrus Company, has accepted a position as consulting engineer to the Hammon Engineering Company, San Francisco, Cal.

J. C. Horne, formerly with the Fellows Gear Shaper Company, of Springfield, Vt., is now acting in the capacity of New England representative of the Fitchburg Machine Works, of Fitchburg, Mass.

William B. Updegraff, who was mechanical engineer with the Harlem Contractor Company, New York City, has accepted a similar position with the Architectural Tile and Faience Company, Maurer, N. J.

Walter E. Marvel, formerly manager of the St. Louis office of the Brida Company, has been appointed western sales manager in charge of the newly established Chicago joint offices of the Detroit Seamless Steel Tubes Company, Michigan Malleable Iron Company, and the Monarch Steel Castings Company.

Obituary

Henry D. Dunbar, inventor of the Dunbar piston packing, and a well known figure in the mechanical railroad field of the East, died in Evarts, Vt., January 18, 78 years old. As a young man he learned the machinists' trade and took up employment in locomotive-building shops. Thirty years of his career, during which time he became well known, were spent as erecting engineer for the Baldwin Locomotive works, during which employment he developed and invented his form of piston packing, in which development he was one of the pioneers.

*Items for this column are solicited.

Analysis of Four Boring Mill Drives*

By J. H. Klinck †

An analysis and comparison of boring-mill drives, as regards speed range and ratios. The drives are: belt with speed box; constant-speed motor with four sets of gears; 1:2 variable-speed motor and speed box; 1:4 variable speed motor without speed box.

*Reprinted by courtesy of *Electric Journal*.
†Commercial engineer, Westinghouse Electric and Manufacturing Company.

It is not always possible to make a direct comparison between belt- and motor-driven equipments. As a consequence, items of major importance in the comparison of the two methods are often overlooked in splitting hairs over minor details.

The possibilities of any given application can be readily analyzed, as has been done with the particular case given below, and some very interesting comparisons can be made with the data thus obtained. The study of the boring mill under consideration is used as an actual example of what has been done in practice.

The ordinary method of changing the speed by shifting a belt on the various steps of a cone pulley has mechanical limitations which render it unsuitable for use where many steps are required over a considerable range. The use of what is called a speed box in connection with the cone pulley is of considerable assistance in such cases. The speed box consists of a group of gear trains and clutches, the combination of gears in action at a given time depending on the particular clutch then in service. In the tool under consideration, Fig. 1, the speed box contains:

Two shafts, six gears (two with sleeves), one double-end clutch, two single-end clutches, two sleeves, four bearings for the shafts and gears, two clutch levers, with supports, supporting pins, clutch blocks, latch pins and other accessories.

These parts are so assembled that it is possible by means of the clutches to obtain four changes in speed, the ratings being:

Clutch 1, 1 to 1; clutch 2, 1 to 2.25; clutch 3, 1 to 5; clutch 4, 1 to 12.5.

On the belt-driven mill shown in Fig. 1 the relation between the diameters of the cones on the four-step cone pulley is such that the speed increment is about 25 per cent. for each step. This gives the following possible changes in speed of the machine table by shifting the belt on the cone pulley alone:

Step 1, 1 to 1; step 2, 1 to 1.25; step 3, 1 to 1.55; step 4, 1 to 1.95, which may be done in connection with any of the four gear combinations in the speed box. The total number of independent speeds which can be obtained is therefore 16. These are, approximately, as shown in Table 1.

Step.	Clutch 1.	Clutch 2.	Clutch 3.	Clutch 4.
1	1	2.25	5	12.5
2	1.25	2.8	6.25	15.5
3	1.55	3.6	7.75	19.4
4	1.95	4.5	9.8	24.4

TABLE 1. SPEED RATIOS OF BORING MILL, FIG. 1.

This table shows that the speed range obtainable is practically 1 to 25. Any speed range desired can be obtained, as this feature is one of design. An increase in the range will of necessity require a larger jump in passing from one speed to another or an increase in the number of gears and clutches used.

Constant-speed Motor Drive

By substituting a constant-speed motor for the countershaft and four pairs of gears—eight in all—for the cone pulley, the same changes in speed can be obtained, but in place of shifting the belt it is necessary to change the gears. Such an installation is shown in Fig. 2.

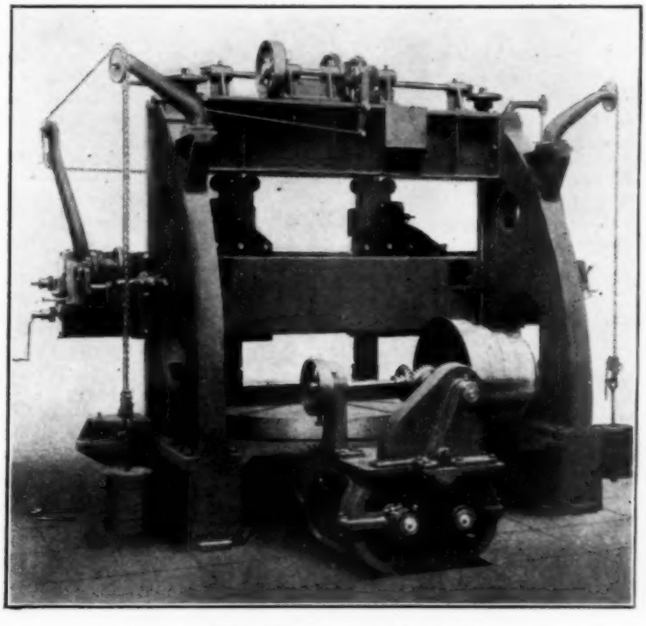


FIG. 1. BELT DRIVE WITH GEAR BOX

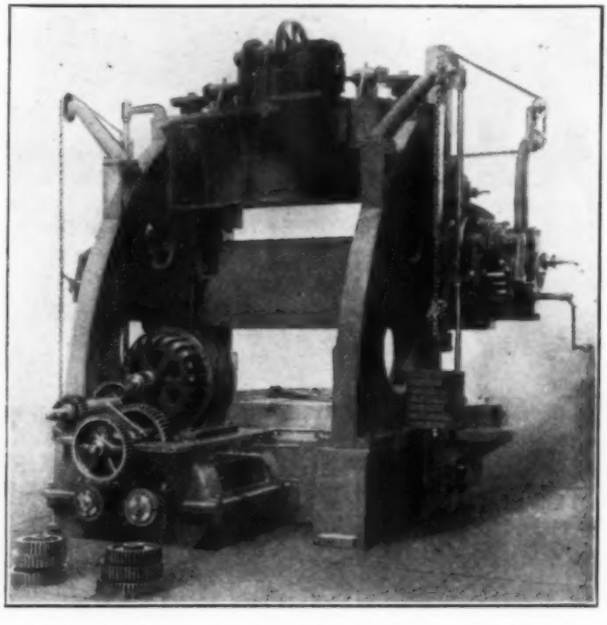


FIG. 2. CONSTANT-SPEED MOTOR DRIVE WITH GEARS

By thus doing away with the cone pulley, a tool is obtained that can be placed anywhere in the shop without reference to any line shaft. This is of particular advantage where crane service is available. The constant losses of a belt-drive transmission system are eliminated as the

motor is running only while the tool is operating. The speed range is identical with that in the belt-driven tool, and the individual speeds are the same.

Speed Box and Variable-speed Motor Drive

The use of the speed box in connection with a motor having a speed range of 1 to 2, is shown in Fig. 3. The equipment shown is operated by means of a reversing-type drum controller which has 16 running positions in the forward and six in the reverse direction. Each of these is available in combination with any of the four speed-box ratios. The speeds that are possible with this arrangement are given in Table 2.

Controller Position.	Clutch 1.	Clutch 2.	Clutch 3.	Clutch 4.
1	1	2.25	5	12.5
2	1.05	2.36	5.25	13.1
3	1.1	2.48	5.55	13.8
4	1.15	2.59	5.75	14.3
5	1.2	2.7	6	15
6	1.25	2.81	6.25	15.6
7	1.3	2.93	6.5	16.2
8	1.36	3.06	6.8	17
9	1.42	3.2	7.1	17.7
10	1.49	3.35	7.45	18.6
11	1.56	3.51	7.8	19.5
12	1.64	3.69	8.2	20.5
13	1.72	3.87	8.6	21.5
14	1.83	4.11	9.15	22.8
15	1.92	4.32	9.6	24
16	2	4.5	10	25

TABLE 2. SPEED RATIOS FOR BORING MILL OF FIG. 3.

On any individual clutch there is thus available a speed variation of 1 to 2, in 15 independent steps, each speed being approximately 5 per cent. higher than the one immediately preceding it. Between clutches 3 and 4 there is a break in the series, but between 1 and 2 and 2 and 3 this does not occur and there is available an unbroken range of 1 to 10.

Variable-speed Motor Drive

The equipment of the tool with a motor having a speed range of 1 to 4, as shown in Fig. 4, and omission of the speed box will make the entire connection between the motor and the driving mechanism of the tool consist of:

Two shafts, four gears, one double-end clutch, two bearings, one clutch lever and accessories.

The motor drives the main shaft either through the intermediate gear, or through the back gears, depending on the position of the clutch. With only two mechanical speed changes in the ratio of 1 to 1 and 1 to 5, there is available a speed range of 1 to 20 with a motor speed range of 1 to 4. Thus by the simple addition of a clutch, a shaft and a pair of back gears, the available continuous range of speed is increased from 4 to 20 times normal. The speeds available in this case are given in Table 3.

Controller Position.	Clutch 1.	Clutch 2.
1	1	5
2	1.1	5.5
3	1.2	6
4	1.3	6.5
5	1.4	7
6	1.55	7.75
7	1.7	8.5
8	1.85	9.25
9	2.05	10.25
10	2.25	11.25
11	2.5	12.5
12	2.7	13.5
13	3	15
14	3.3	16.5
15	3.65	18.25
16	4	20

TABLE 3. SPEED RATIOS FOR BORING MILL OF FIG. 4.

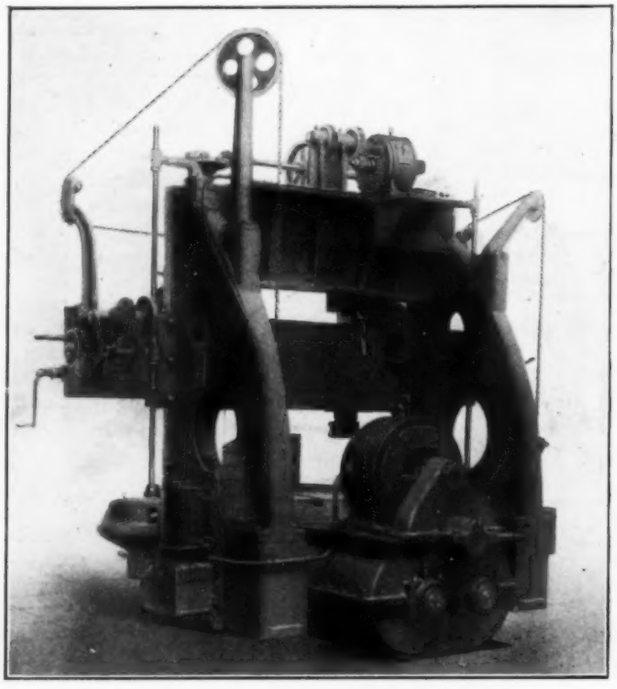


FIG. 3. VARIABLE-SPEED MOTOR DRIVE 1:2 AND GEAR BOX

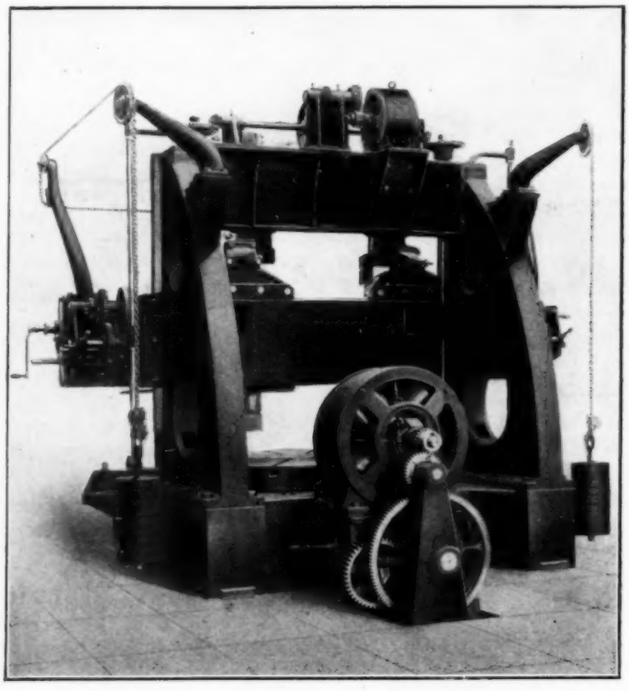


FIG. 4. VARIABLE-SPEED MOTOR DRIVE 1:4 NO GEAR BOX

In this case the total speed range is 1 to 20 instead of 1 to 25 as in the previous instances. The speeds obtainable are, with the single exception of the gap between the clutches, each an increase of 10 per cent. over the one immediately preceding. While the table shows a gap at this point, in practice this gap can be entirely eliminated either by operating the motor over a slightly greater range than 1 to 2, or by making the ratio of the back-gear combination slightly less than 1 to 5.

While the total number of speeds available with the 1 to 4 motor and no speed box is smaller, this is in no sense a detriment from an operating standpoint, because the latter combination gives speed increments smaller than are usually needed in practice. With the 1 to 2 motor the speeds have a 5 per cent. increment, while with the 1 to 4 motor the increment is 10 per cent. The speed range on the average work is from 15 to 30 feet per minute; when running at 20 feet per minute, a 5 per cent. increase in speed gives 21 feet and a 10 per cent. increase gives 22 feet. It is difficult to imagaine actual operating conditions under which 10 per cent. increments will not answer all requirements; if, however, such conditions do exist, the 1 to 2 motor with the speed box is preferable. The general relation

existing between the different types of equipment is as follows:

SUMMARY

The belt-driven mill with the speed box has a speed range of 1 to 25 composed of four independent series with a variable ratio between series. Each series consists of four speeds with increments of 25 per cent., making 16 speeds in all. The methods of control is by means of shifting belt or clutches separately or together.

The constant-speed motor with four sets of gears gives a speed range of 1 to 25 with the same speed characteristics as the belt-driven tool; the change in speed in this case is affected by changing gears or shifting clutches together or separately.

The 1 to 2 adjustable-speed motor with the speed box gives a speed range of 1 to 25 in 63 steps. These steps occur in four series corresponding to the four clutches of the speed box; each series contains 16 speeds corresponding to the 16 controller notches. The speed increment is 5 per cent. for the first 31 steps, a slightly larger increment on the thirty-second step, and 5 per cent. for the last 31 steps.

The 1 to 4 adjustable-speed motor without the speed box gives a speed range of 1 to 20, consisting of one continuous series of 31 steps, 10 per cent. increment. The method of control is by means of a drum controller and two clutches, the controller giving 16 speeds with each clutch.

Regarding ease of control there is no dispute. With the motor-driven tool the operator can start or stop the tool or change the speed without having to leave his working position except for throwing the clutches.

The illustrations show standard equipments made by the Niles Tool Works Company, of Hamilton, O. Each motor-driven mill of this type has a motor mounted on top for raising and lowering the crosshead. On the belt-driven mill the position of the crosshead is adjusted by means of a belt, but the illustration, Fig. 1, shows the pad for the application of a bracket should it be desired to convert the mill to motor drive at a future time. Practically all modern heavy belt-driven tools are provided with pads of this kind upon which to mount motors.

An inventor, an Italian engineer, of a new sea motor, for which great claims are made, states that the reason why the energy of the waves has never been harnessed is because everyone has ignored their double force, one proceeding from the hight of the wave's crest above the water's level, and a separate force contributed by the body of the wave as it rolls up on the shore. His invention consists of a contrivance that utilizes the double force mentioned. According to report this invention has been favorably investigated by the Italian Admiralty.

Interesting Application of the Oxyacetylene Cutting Process

In a recent fire in the Cincinnati Chamber of Commerce building, which ruined the interior of the structure, thus destroying the home of that organization, the quarters of the Business Mens' Club and the offices of other tenants, the three upper floors, which were suspended from steel girders resting upon the walls of masonry, were dropped by the buckling of the suspension members, and six men at work in the lower part of the building were buried under tons of warped and twisted girders, I-beams, and débris of all kinds. Owing to the character of the wreckage and also to the fact that the walls of the structure remained practically intact, it was found impossible to remove the girders and metal work generally, in order to locate the bodies of the victims, without cutting up the steel work and removing it piecemeal.

To accomplish this, two Davis-Bournonville oxyacetylene outfits, with cutting torches, were installed in the ruins by the Ohio Welding and Manufacturing Company, of Cincinnati, and the process of cutting the beams and girders was carried on day and night until the six bodies were recovered. The I-beams were of various sizes, ranging up to 36-inches and only those who viewed the ruins can appreciate the tangle of twisted and bent metal that had to be operated on in this manner. Wherever a beam was twisted under another, the oxyacetylene cutting torch was applied and the beam severed and then possibly cut at several other points to enable the workmen to remove it. As soon as steam hoisting gear was installed, fewer cuts were required in each girder, and the work of clearing up the wreckage was correspondingly facilitated.

The cuts were made through the heavy sections, as shown in the accompanying illustration, in four or five minutes each, and the rapidity with which the operation was carried on with the oxyacetylene flame was undoubtedly a revelation to thousands of individuals who followed with interest the accounts in the local papers of the progress made from day to day in the work.

USING AN OXYACETYLENE TORCH IN CUTTING UP STEEL SECTIONS

The utilization of the cutting-torch process for purposes of the kind described seems to be becoming common.

Next to discovering perpetual motion, probably one of the most alluring fields for experiment on the part of scientists in search of great reward is that of utilizing the radiant-heat energy of the sun and the kinetic and potential energy of the wind and waves. A recent means devised to utilize the sun's radiant energy consists of an air-tight glass chamber or boiler, in which water is heated by the sun rays and steam at atmospheric pressure is generated, and a low-pressure turbine outfit to utilize the steam so generated. The turbine may operate either an electric generator or, preferably, a pump for raising water to an elevated reservoir from which the water flows as needed to run a water-wheel and generator.

Shop Equipment News

2¼x26-inch Combination Turret Lathe

This machine was designed to machine bar stock, forgings and castings using simple tools.

The machine handles bar work up to 2¼ inches diameter and 26 inches long, with the bar outfit of tools, also forgings and castings to 14 inches diameter with the chucking outfit. The machine will swing 19 inches in diameter.

The head is provided with friction back gears and three-step cones for 3½-inch belt.

The work has no end motion when the chuck is closed, making it possible to do second-operation work, requiring exact shoulder lengths. The chuck jaws do not overhang, therefore, short work can be gripped without tilting the jaws. The jaws are easily removed and inserted without dismantling the chuck.

A roller feed is used to feed the stock, the centering jaws and rolls being operated together automatically. Any section of bar can be fed. The same lever that closes the chuck operates the roller feed.

An oil hole is provided under each tool space in the turret for use with oil tube drills, etc., this in addition to the regular oil pipe. A swinging stock stop is attached to the front of the saddle.

The cross slide is provided with independent adjustable stops for each tool on turret arranged to trip the automatic feed. A very rigid stop is used to locate the turret in its central position.

The carriage has automatic adjustable stops for each turret hole and four auxiliary stops which may be used in any combination desired, all these stops trip the automatic feed.

Power feed is provided for both the cross and longitudinal movement to turret. It is of the geared type, giving four changes instantly obtainable by moving the lever shown at the front of head. Both feeds are reversible by means of the lever at front of feed box.

This machine is built by the Acme Machine Tool Company, Cincinnati, Ohio.

ANY and all new or improved machines, tools or shop appliances of interest to men responsible for results in machinery-making plants will be briefly illustrated and described here — the machine shop news.
A more full and detailed description will be given — when it is real news — if it can appear here first — before it is sent to other papers. ALL descriptions appear in ALL four editions of the paper—Weekly, Monthly, Weekly English and Weekly German

Cupror Metal

This metal possesses a gold-like color, and is claimed to be noncorrodible. Its texture is not unlike that of gold, which characteristic is conducive to toughness and ductility. The metal is made in various forms of sheets, tubing, castings, ingots, wire and rods, and is readily adaptable for tooling, stamping, drawing, spinning, etc. Its quality of high luster makes it very desirable for many purposes, and it is now available for the market through the Cupror Company, 50 Church street, New York City.

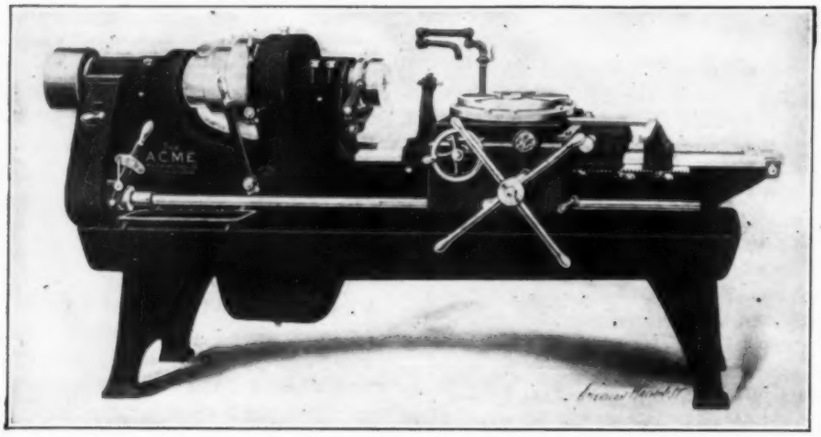
A Two-Spindle Boring Machine

The halftone shows a heavy vertical boring machine built by the Hoefer Manufacturing Company, Freeport, Ill.

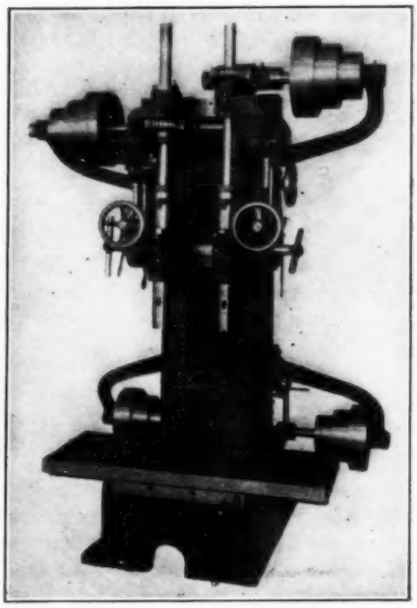
The machine is self-contained, in that it has its own countershaft attached directly to the main casting. The spindle noses are reamed with a No. 5 Morse taper and provided with a driving slot for the tools. The drift hole is run through the nose instead of the sleeve and spindle, giving the spindles additional strength. The heads are gibbed to the cross rail, doweled and bolted to the column of the machine.

The right spindle head is stationary while the left head is adjustable and can be very easily moved by means of a handwheel and screw shown at the right side of the machine. The heads can be set from 4⅝ to 12 inches apart. Each head is self-contained, having its own driving belt and independent geared power feed.

The geared feed is controlled by levers within handy reach of the operator. The



2¼x26-inch Combination Turret Lathe



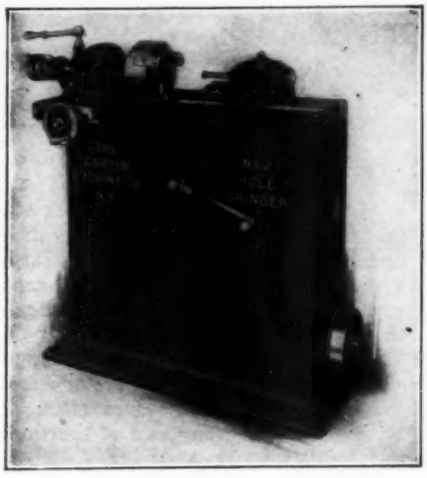
A Two-spindle Boring Machine

standard feeds are from 0.008 to 0.0625 inch per turn of spindle.

The table is 18x48 inches moved by a rack and pinion. A job can be set on one end of the table while the two spindles are at work at the other end.

Garvin Hole Grinding Machine

The halftone shows a machine built by the Garvin Machine Company, New York, for grinding the holes in such work as hardened gears for automobiles. It will grind holes from ⅞ to 4 inches diameter by 4 inches deep, and will swing work 9 inches diameter. The machines



GARVIN HOLE-GRINDING MACHINE

can be equipped with various quick-acting chucks. Where it is desired to face the work at the same chucking, a two-spindle grinder head is furnished, the one spindle being offset to take care of the facing. The machine is very compact, the floor space occupied being but 30x48 inches.

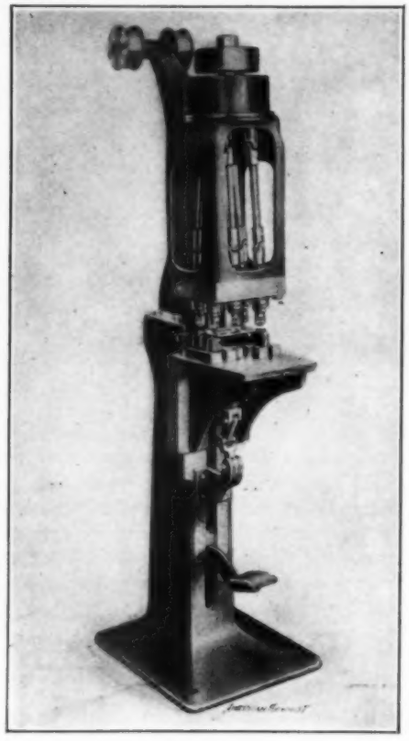
A 5-Spindle Rivet Spinning Machine

The machine herewith illustrated shows a special five-spindle noiseless rotating roll-rivet spinning machine recently brought out by the Grant Manufacturing and Machine Company, of Bridgeport, Conn.

This machine differs materially from their regular line of single-spindle riveters in that the table is arranged to move up and down, bringing the work in contact with the spinning rolls through the medium of a toggle. The spindles can be individually adjusted vertically to accommodate varying hights of work to be riveted. The principle which is used for rotating the spindles from one common pulley is practically the same as the method used in multiple-spindle drills. The spiral gears which operate the spindles are inclosed in a cast-iron case and are partially immersed in oil.

The roll holders and the lower part of the spindles are mounted in a solid casting which is attached to the main frame of the machine. The locations for the spindles in this casting are bored to exactly match the location of the posts which are to be riveted; it being intended to use locating plates to accommodate work of varying center distances and shapes.

The machine is readily adapted to quite a variety of work where the parts to be riveted are not too close together as it is necessary to have the riveting spindles of sufficient size to insure ample strength.



A 5-SPINDLE RIVET-SPINNING MACHINE

A Double Spindle Boring Machine

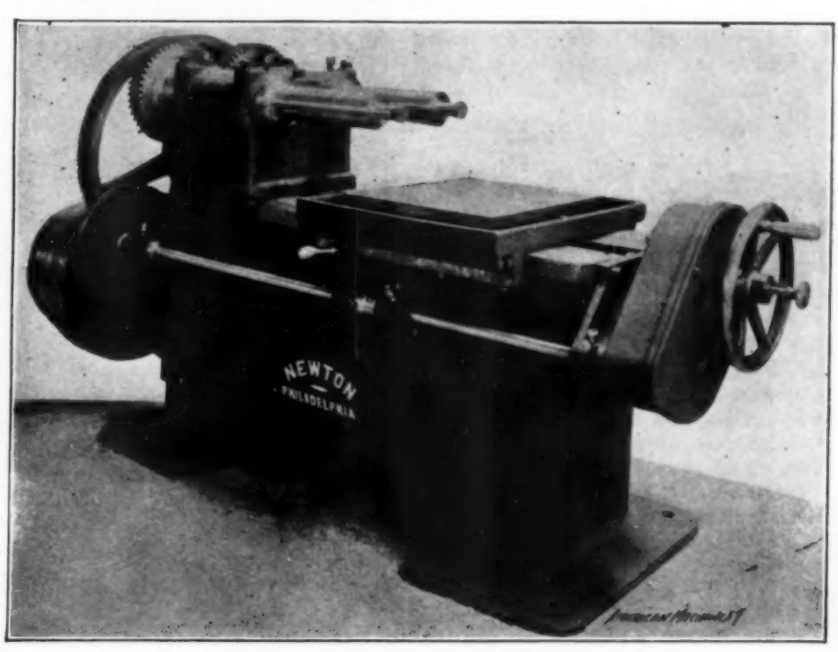
The spindles of this machine are 4 inches in diameter, and revolve in bronze-bushed cap bearings 14 inches long. The extension for the boring bar is 3¼ inches in diameter; the distance between spindle centers is 10 inches, and the distance from the center of the spindle to the top of the work table is 8 inches.

The machine is furnished with three changes of in-and-out gear feed and hand adjustment; the feed has automatic release, the drive is by means of a three-step cone, the pinion on the cone meshing with the large driving gear, on the hub of which is mounted a pinion equal in length to the width of both the spindle-driving gears which it drives. The stresses are thus opposed and chatter eliminated.

The working surface of the table is 18 inches long and 20 inches wide, entirely surrounded by an oil pan. Cylinders 14 inches deep can be machined.

This machine is intended to cover a field of plain boring, in which a simple inexpensive rigid machine can be utilized. Additional heads can be placed on the machine should different center distances be required.

The machine is built by the Newton Machine Tool Works, Inc., Philadelphia, Penn.

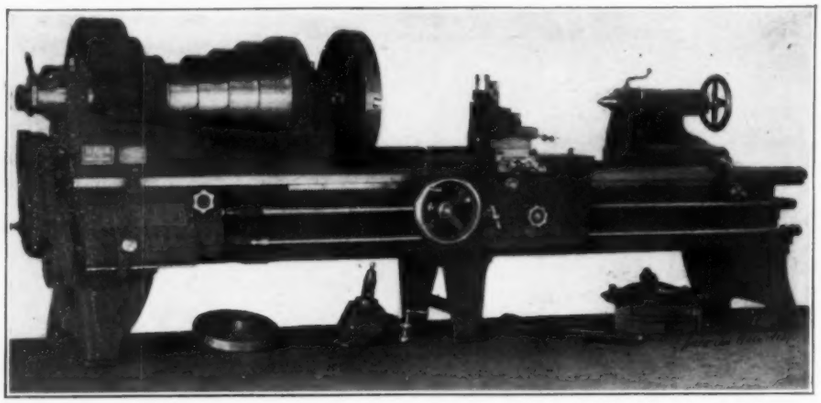


A DOUBLE-SPINDLE BORING MACHINE

A 24-inch Heavy Duty Lathe

The halftone shows one of a new line of heavy-duty double back-geared lathes built by the F. E. Reed Company, Worcester, Mass.

They are built in three sizes, from 18 to 22 inches, with three-step cones and in three sizes, from 24 to 30 inches, with four-step cones, the last two sizes being in preparation. The beds, heads, carriages and aprons are exceptionally heavy. Either compounds or plain rests are supplied and taper attachments can be furnished with either style rest.



A 24-INCH HEAVY-DUTY LATHE

The lathes are all equipped with quick-change gear mechanism, giving 60 changes to both lead screw and feed rod, and so arranged that both cannot be operative at the same time. The countershaft is of the friction type with two speeds.

Universal Wood Gear Cutting Machine

The accompanying illustrations show a new gear-cutting machine designed and placed upon the market by the Newark Gear Cutting machine Company, of Newark, N. J., for the purpose of cutting the teeth of wood gears for patterns, especially spiral or helical gears.

The machine has a capacity for spur gear patterns up to 8 feet diameter by 24-inch face; and helical or spiral gear patterns up to 7 feet diameter by 24-inch face. Any lead or angle of worm may be cut, as well as any number of threads; and any lead or angle of helical gear may also be cut. The range of pitches which the machine is capable of cutting is, of course, very large. By using fly cutters, all pitches ranging from 1-inch circular up to 7-inch circular can be easily taken care of, and of course, heavier pitches can also be cut. The finer pitches, where required, can also be cut by using regular rotary gear cutters.

The wooden pattern blank is mounted upon the work arbor, or upon the face-plate direct. Blocks of wood may also be cut on this machine, for use in gear-tooth molding machines. A rim support is provided for taking the thrust of the cut, in large gears.

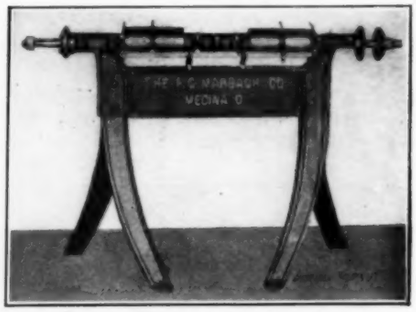
The work head is adjusted on the bed, to take care of the various diameters to be cut; the adjustment being obtained by means of screw, with dial graduated to read to thousandths of an inch.

When cutting spur-gear patterns, a formed fly cutter is used, mounted upon the spindle as shown in the lower cut. This spindle makes 3200 revolutions per minute. When cutting helical gears or worms, an endmill form of fly cutter is used, mounted upon the endmill attachment shown in the upper cut, making 4200 revolutions per minute.

A motor drive can be readily provided for, as the machine pulley runs at constant speed. No countershaft is required.

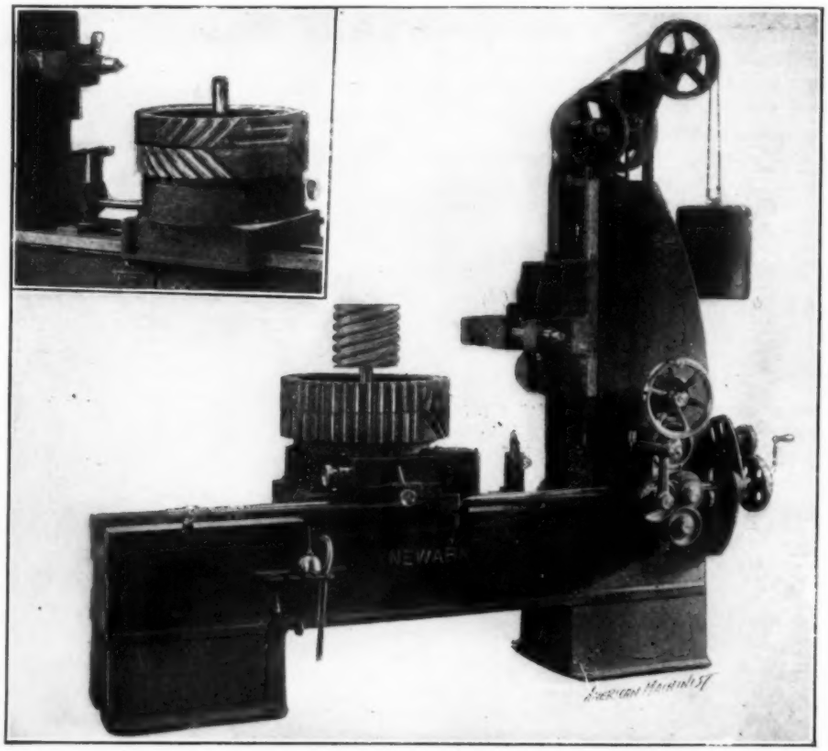
A Grinding and Polishing Machine

The halftone shows a grinding and polishing machine built by the F. G. Marbach Company, Medina, O. The spindles measure 62 inches over all, are 48 inches between wheels, 1⅜ inches diameter in the bearings and take wheels with 1¼-inch hole. The shifters are conveniently placed so that either wheel can be started or stopped instantly.



A GRINDING AND POLISHING MACHINE

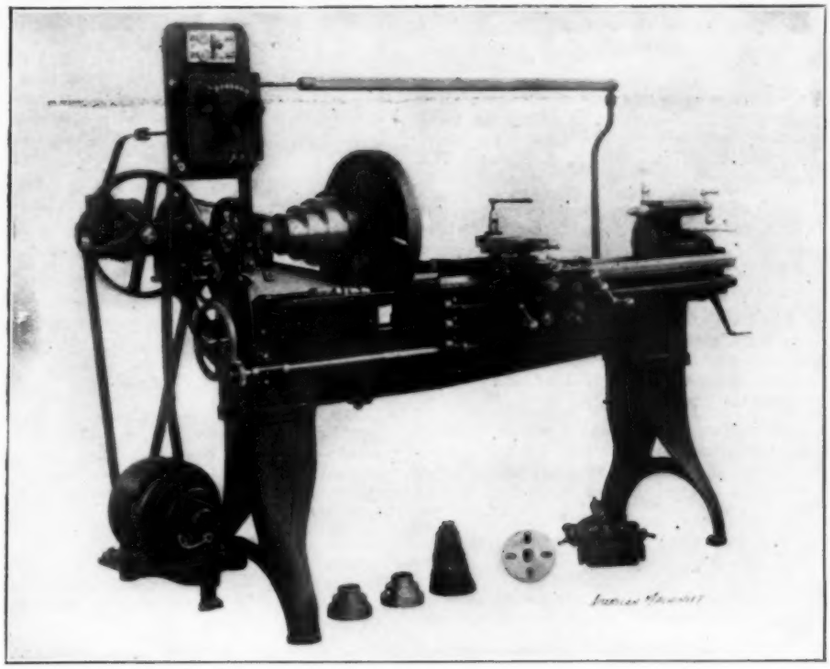
The front legs are curved in order to give ample room for the operator's feet and allowing him to move as much as necessary to bring any part of the work to the wheel.



UNIVERSAL WOOD GEAR-CUTTING MACHINE

A Motor Driven Extension Gap Lathe

The halftone shows a self-contained motor-driven 12x22-inch extension-gap lathe built by the Barnes Drill Company, Rockford, Ill.



A Motor-driven Extension-gap Lathe

Any constant-speed motor for either direct or alternating current may be used, giving eight changes of spindle speeds, or, if desired, a variable-speed motor can be used to increase the number of spindle speeds. The motor is belted to driving-shaft pulley, as shown. On this shaft are two friction-clutch gears giving forward and reverse speeds.

Power is transmitted from the drive cone to the spindle cone by means of the 2-inch belt, with provision for tightening.

Starting, stopping and reverse motion of the lathe spindle is controlled by the shifter above the lathe.

The outfit is furnished wired, belted and ready to run as soon as feed wires are connected.

A Portable Revolving Elevator

The line cut shows a portable elevator for use in factories and known by the trade name Revolvator. The box or bale is placed on the platform when down and by means of a crank and gears the platform is then raised to any level desired. Rollers are provided on the platform so that as soon as the box reaches the desired level one man can easily slide it into the space where it is to be stored. The elevator is provided with two double gears, one for high speed and one for low. Bales, etc., up to 800 pounds can be easily handled on the high gear and bales weighing from 800 to 1500 pounds or more can be handled by the low gear.

A Portable Revolving Elevator

The device has a revolving base so that the load can be swung and unloaded at any point. The Revolvator is built by the New York Revolving Portable Elevator Company, Jersey City, N. J.

Correction of Address

The address of the Medhus-Pihl Manufacturing Company, whose pliers were illustrated in this department a few weeks ago, is Hastings, Minn., instead of Michigan, as stated at that time.

Increasing Shop Capacities

Metal Working

NEW ENGLAND

The Wm. J. Hyland Company, plumbers, Springfield, Mass., will build a new plant.

The blacksmith shop of G. Killham, Dresden, Me., destroyed by fire, will be rebuilt.

A. Lewenberg, of Dorchester, is erecting a new garage on Blue Hill avenue, Dorchester, Mass.

The H. B. Smith radiator plant, of Westfield, Mass., was destroyed by fire. Loss, $20,000.

The American Ship Windlass Company, Providence, R. I., will make extensive improvements.

News items for the sales department — where more equipment will be needed. Authentic news is solicited for this department, not rumors or gossip — facts

The Springfield Power Associates are building a new garage on Dwight street, Springfield, Mass.

Henry Rosen is building a new garage on Prospect and Hamspire streets, Cambridge, Mass., to cost $25,000.

J. F. Killham, of Beverly, Mass., has bought a three-story factory building and will occupy it for his bicycle business.

The New York, New Haven & Hartford Railroad is to change site of its $200,000 roundhouse from New Haven to West Haven.

The Boston & Maine Railroad has a list of tools out for repair shops, at Lyndonville, Vt., including planer, milling machine, lathes, tool grinder, bolt cutter, drills, etc.

The Climax Specialty Company, of Norwich, Conn., has been incorporated with $50,000 capital to manufacture metal goods. Tyler Cruttenden, Jas. C. McPherson and Arthur J. Crowell, incorporators.

The C. W. Kelsey Manufacturing Company, located in the old buildings of the Cheney Silk Mills, Hartford, Conn., will start at once on the manufacture of motorettes. A one-story addition is to be added in the spring.

MIDDLE STATES

Conrad Mason, Philadelphia, Penn., will build a two-story garage.

The Hazleton (Penn.) Iron Works has plans prepared for a new plant.

The Favorite Stove and Range Company, Piqua, Ohio, will erect a new foundry.

Fire destroyed the plant of the Star Expansion Bolt Company, Bayonne, N. J.

The Schmidt Electric Air Pump Company will construct a plant at Hazleton, Penn.

The Carroll Foundry and Machine Works, Bucyrus, Ohio, will erect a large addition.

Fire did $75,000 damage at the plant of the Griswold Motor and Body Company, Detroit, Mich.

The Detroit (Mich.) Creamery Company will install a machine shop to take care of repair work.

The Dill & McGuire Lawn Mower Company, Richmond, Ind., will erect a new $100,000 factory.

Dodge & Zuill, Syracuse, N. Y., manufacturers of washing machines, will move into larger quarters.

The Silver Manufacturing Company, Salem, Ohio, will build a large addition to its machinery plant.

The Milwaukee (Wis.) Spring Metal Bed Manufacturing Company is looking for suitable site for a new plant.

The Elgin Watch Company, with offices at 302 Wabash avenue, Chicago, Ill., is looking for site for a branch plant.

Ellis M. Hughes, Racine, Wis., is at the head of a movement to organize a company to erect and equip a foundry plant.

The Dayton Auto Truck Company, of Dayton, Ohio, increased its capital from $50,000 to $200,000 to provide for increased facilities.

The Public Service Corporation, of New Jersey, will build a new car barn on Springfield avenue, Newark, N. J., to cost $700,000.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids, February 21, for one gap grinder (schedule 3276).

Fire caused $10,000 damage at the plant of the Linderman Manufacturing Company, Muskegon, Mich. The company manufactures a dovetailing machine.

The Coloroll Manufacturing Company, Orange, N. J., which manufactures a printing machine, has outgrown its present quarters and is looking for another site.

The Crucible Steel Company of America will make improvements at the Atha plant, Newark, N. J., including the installation of a 1500-ton press for pressing ingots.

The Simpson Brothers Company, of Portsmouth, Ohio, which has been manufacturing castings on a small scale proposes to go into the foundry business more extensively.

The Dykes Aëroplane Company, of Yonkers, N. Y., has been incorporated to manufacture aëroplanes. Capital, $30,000. Theodore Windel and Geo. Guhman, of Brooklyn, directors.

The Clipper Novelty Company, Syracuse, N. Y., has been organized with $10,000 capital to manufacture fruit clippers by Chas. M. Crouse, Frank M. A. Bouta, Frank Tirrell, etc.

Frederick A. Smith Company, New York, has incorporated to manufacture and deal in automobiles and supplies. Capital, $25,000. Incorporators, F. A. Smith, A. Rosen, M. Wolf.

The Bishop Manufacturing Company, New York, has been incorporated to manufacture machinery, tools, etc. Capital, $25,000. Incorporators, A. G. Bishop, H. R. Bishop, A. H. Tefel.

The Hunt Safety Sash Lock Company, Newburgh, N. Y., has been organized to manufacture hardware. Capital, $25,000. Incorporators, R. H. Catchart, R. G. Stewart, J. E. Easeman.

The Conneaut Auto Shop Company, Conneaut, Ohio, has been organized with $10,000 capital to operate a garage and repair shop by V. E. Best, J. H. Wilcox, Matt Y. Spalding, etc.

The Avery, Loeb Company, Columbus, Ohio, has been incorporated to manufacture electrical fixtures. Capital, $25,000. Incorporators, Oscar Avery, A. E. Loeb, C. W. Hammond, etc.

The Meyer Paper Company, Cleveland, Ohio, has been incorporated with $30,000 capital to make all kinds of paper. Incorporators, Walter J. Meyer, Robert E. Meyer, Lem S. Miller, etc.

The Peterson-Brown Company, Mansfield, Ohio, has been incorporated with $10,000 capital by John F. Peterson, Edw. N. Brown, Wm. A. Schuster, etc. Will manufacture locks, etc.

The Royal Silver Manufacturing Company, Newark, N. J., has been incorporated to manufacture silver novelties. Capital, $30,000. Incorporators, Ruben Udell, E. Singer, W. T. Goldsmith.

The Buckeye Steel Castings Company, of Columbus, Ohio, has purchased a tract of land at Indiana Harbor, near Gary, Ind., where it is planned to erect a plant in the near future.

The Hardenbergh & Eddy Company, New York, has been incorporated with $60,000 to manufacture calculating machinery. Incorporators, J. F. McDavitt, M. A. Fischer, G. C. Shafter.

Hanson & Van Winkle Company, manufacturer of electroplating machinery and platers' supplies, will build an addition to its present works at 321 Chestnut street, Newark, N. J.

The Smith-Kilbourne Company, Logansport, Ind., has been incorporated with $10,000 capital to manufacture vehicles, automobiles, etc. Incorporators, W. B. Smith, O. N. Smith, E. H. Kilbourne.

The Brush Texas Motor Company, Jersey City, N. J., has been incorporated with a capital of $10,000 to manufacture automobiles, etc., by H. C. Coughlan, L. H. Cunther, John R. Turner.

The International Airship Company, Paterson, N. J., has been incorporated with $250,000 by Victor L. Ochoa, Edo Van Winkle and William S. Martin to manufacture flying machines, etc.

The Banard Carburetor Company, Dayton, Ohio, has been organized to manufacture and sell carburetors and auto parts by Davis Barnard, C. L. McCrea, Roscoe F. Stanter, etc. Capital, $100,000.

The Lackawanna Manufacturing Company, making valveless motors, sharing a building with the Coldwell Lawn Mower Company, Newburgh, N. Y., is considering the erection of a factory of its own.

The Victoria Company, Rochester, N. Y., has been organized to manufacture suction cleaners, hardware specialties, etc. Capital, $40,000. Incorporators, B. P. Mills, M. F. Van Buskirk, W. S. Johnson.

The Siler-Petit Manufacturing Company, of Fort Wayne, Ind., has been incorporated with a capital of $250,000 by E. E. Siler, B. F. Petit, G. S. Hanford, M. J. Marten and E. M. Hulse, to manufacture pumps.

The Foundries Company, Orrville, Ohio, has been formed with a capital of $10,000, to operate blast furnaces and make castings and machinery of all kinds by H. D. Shannon, D. Ed. Seas, George Wendling, etc.

The Cleveland Regal Sales Company, Cleveland, Ohio, has been organized to operate a sales agency and garage. Capital, $10,000. Incorporators, Harry L. Lance, Celia L. McGowan, Benjamin R. Stevens, etc.

The National Metal Specialty Company, London, Ohio, has been organized with $50,000 capital to manufacture and sell all kinds of metal articles by Clyde L. Thomas, M. B. Armstrong, Harry C. Haines, etc.

The Ogden Rowotype Company, Dover, Del., has been incorporated to manufacture composing machines, bars and lines for type. Capital, $3,000,000. Incorporators, Albert Ogden, Arthur W. McGobney, of Chicago, Ill.

The Leogar Structural Company, West Dunellen, N. J., has been organized to manufacture structural steel and iron, metal work, etc. Capital, $250,000. Incorporators, Wm. A. Garrigues, Arthur T. Gallup, Jerome M. Bell.

Mara Power Wagon Company, Cleveland, Ohio, has been incorporated with a capital of $750,000 to make and sell automobiles and parts of all kinds. Incorporators, Millard H. Mason, Robert P. Abbey, Thomas S. Dunlap, etc.

The Sheffield File Company, New York, has been incorporated to manufacture and deal in cutlery, manicure files, tools, etc. Capital, $25,000. Incorporators, M. A. Rice, Montclair, N. J.; S. R. Perry, New York; E. W. Renne, Jersey City.

The Morton Heer Company, Portsmouth, Ohio, has been incorporated to manufacture all kinds of gasolene engines, traction engines and to make self-propelled vehicles. Capital, $10,000. Incorporators, Frank E. Adams, Christ Heer, etc.

The Marion (Ohio) Shovel and Dredge Company, which is now erecting four buildings, consisting of machine shop, forge and structural shop, woodworking shop, power house, will need some equipment. Foundry and boiler shop will be erected later.

The American Automobile Manufacturing Company has purchased the buildings now occupied by the New Albany Woolen Mill Company, at New Albany, Ind., and will take possession immediately after the removal of the machinery of the Woolen Mill company.

The Crucible Steel Company of America has formed another company under the title of the Pittsburg Crucible Steel Company and has secured property of the Midland Steel Company, where extensive improvements will be made. Will manufacture a high-grade open-hearth steel.

The American Motors Company, which takes over the plants and properties of the American Motor Car Company, of Indianapolis, Ind., has been incorporated with a capital of $1,000,000. Incorporators, J. I. Handley, New York: James E. Kepperly and A. D. Ogborn, Indianapolis. The new company will greatly enlarge its present facilities.

SOUTHERN STATES

The Merrill-Stevens Company, Jacksonville, Fla., will enlarge its machine shop.

The Thomas Grate Bar Company, of Valdosta, Ga., will establish a plant at East Birmingham, Ala.

Morris Iron Works, Frederick, Md., has completed organization and will triple the size of its plant, the improvements to include a main building containing more than 61,000 feet of floor space.

WEST OF THE MISSISSIPPI

Wm. Meyer and M. B. Sprague, of Box Elder, Mont., will erect a blacksmith shop.

The Washington Stove Works, Everett, Wash., will build an addition to its factory.

W. P. Lyon, Fresno, Cal., will build a commercial garage. Modern repair equipment will be installed.

The Qualm Vacuum Cleaner Company, of Waterloo, Iowa, will move its plant to Charles City, Iowa.

The Iowa Central Railroad has commenced to rebuild its roundhouse at Marshalltown, Iowa, recently burned.

The Banner Iron Works, 4620-24 Shaw avenue, St. Louis, Mo., has taken out a permit for a one-story shop.

J. G. Edwards, Portland, Ore., will build a commercial garage and repair shop. Modern equipment will be installed.

C. E. Lord and W. H. Foster will build a commercial garage at Olympia, Wash. Modern repair machinery will be installed.

It is semi-officially announced that the Southern Pacific Railroad is planning for the erection of extensive shops at Goshen, Cal.

A. N. Davidson, Los Angeles, Cal., will build a commercial garage and repair station. Modern equipment will be installed.

The American Wire Fabrics Company will succeed the American Wire Cloth Company, at Clinton, Iowa, and plant doubled in size.

Plans have been prepared for a new plant for the Coin Machine Manufacturing Company, at Grand avenue and East Hoyt street, Portland, Ore.

The Pacific Sash-Weight Foundry has been incorporated at Los Angeles, Cal., by E. C. Wilson, J. W. Beggs and F. A. Buchanan, with $25,000 capital.

The Heard Sheet Metal Works (L. B. Heard), Los Angeles, Cal., has purchased property and will erect a three-story factory building. Modern equipment will be required.

W. R. Morehouse (German-American Saving Bank), Los Angeles, Cal., is having plans prepared for a commercial garage and repair station to be erected on Pasadena avenue. Modern facilities will be installed.

Equipment will be required for the manual arts high school to be established by the State of California, at Santa Barbara; $160,000 will be expended upon buildings and $70,000 for equipment. State Engineer Ellery is in charge of the project.

Extensive machinery will be required in the manual-training department of the new Polytechnic High School to be erected at San Francisco, Cal. Plans are being prepared by City Architect A. I. Coffey. The department will include a carpenter shop, cabinet and patternmaking rooms, machine shops, foundry, blacksmith and electrical shops; they will be thoroughly equipped.

CANADA

The west end plant of the Canadian Steel Corporation, Hamilton, Ont., was destroyed by fire. Loss, $50,000.

The British Columbia Marine Railway is contemplating the erection of a large shipbuilding plant at Victoria, B. C.

The Canadian Automatic Transportation Company, branch of the Automatic Transportation Company, of Buffalo, N. Y., will erect a plant at Welland for the manufacture of electric vehicles.

GENERAL MANUFACTURING

NEW ENGLAND

R. Berberian, Providence, R. I., will enlarge its enameling plant.

The Charlton Mill, Fall River, Mass., is building a new boiler house.

The Jenks Paper Box Company, Pawtucket, R. I., will erect an addition.

The Bourne Mills, Fall river, Mass., are in the market for a steam boiler.

The town of West Medway, Mass., intends to purchase a stone crusher.

The city of Gloucester, Mass., is in the market for a stone crusher.

The Cliftondale (Mass.) Screen Company is in the market for a saw table.

The city of New Bedford, Mass., will make improvements in its water systems.

Fire badly damaged the plant of the Spaulding Blue Print Company, Boston, Mass.

The Middleboro (Mass.) Gas Company contemplates the erection of a new gas plant.

The bottling establishment of H. Nardolillo, Providence, R. I., was badly damaged by fire.

William F. Graham, South Wellfleet, Mass., will purchase a five-horsepower gas engine.

A new boiler plant is to be erected at the International Rubber Company, Barrington, R. I.

W. D. Quimby & Co., Boston, Mass., are in the market for a 15-ton refrigerating machine.

The dyestuff manufacturing plant of J. D. Lewis, Providence, R. I., was badly damaged by fire.

The Bristol Manufacturing Company, New Bedford, Mass., is extending its weaving equipment.

The Woodside Woolen Company, Northboro, Mass., will require new power-plant equipment.

The Yale Knitting Company, Malden, Mass., is to erect a three-story addition to its present factory.

The city of Holyoke, Mass., will build an addition to the laundry at the city farm to cost $10,000.

The Boston Cold Storage and Terminal Company, Boston, Mass., is to erect a seven-story factory.

Plant of the Union Carpet Company, Watertown, Mass., was damaged by fire to the extent of $15,000.

The city of Worcester, Mass., contemplates installing an electric-light plant at the Worcester county jail.

Explosion of a flywheel caused $50,000 damage at No. 7 mill of the Boott Cotton Company, Lowell, Mass.

The Mains, Dolley & Ward plant, for the manufacture of baseball bats, will locate shortly in Fryeburg, Me.

An explosion at the river works of the General Electric Company, Lynn, Mass., wrecked the engine room.

The Anawan Mill, Fall River, Mass., has leased more property which will be used in connection with cotton plant.

The W. C. Miles Company, 89 Riverside avenue, Medford, Mass., is in the market for a buzz planer and swing saw.

The Lorraine Manufacturing Company, Pawtucket, R. I., is drawing plans for additions to its dye-house equipment.

John F. Moffit, Boston, Mass., represents a syndicate which contemplates locating a gas plant and system at Franklin, Mass.

Fire destroye dthe plant of the Acme Fibre Company, at Grasmere near Manchester, N. H., entailing a loss of $30,000.

Fire starting in the engine room of the Sturtevant Mill Company, Dorchester, Mass., damaged the plant to the extent of $10,000.

The Hampden Machine Screw Company, Springfield, Mass., will install a gas-producer plant of 125 horsepower in the near future.

The Rockingham County Light and Power Company will make additions to its power-station equipment. C. H. Dean, Boston, is engineer.

A syndicate headed by Hornblower & Weeks, bankers, Boston, Mass., has purchased the Harmony Mills, Cohoes, N. Y., and will spend $2,000,000 on improvements.

Ex-Senator Jas. F. Shaw, of Boston, has been elected president of the Longacre Electric Light and Power Company. The company contemplates the expenditure of $10,000,000 in the initial plant.

The Worcester (Mass.) Gas Light Company has petitioned the Massachusetts gas and electric light commission for authority to issue $400,000 of stock, part of which will be used for additions to its plant.

MIDDLE STATES

Holland, Mich., will install pumping system.

The Rome (N. Y.) Wire Company will erect a new one-story mill.

The W. J. Orr spoke factory, of Bellefontaine, Ohio, was burned.

The Chocolate-Menier Company will erect a large plant in Hoboken, N. J.

The city of Rockford, Ill., is considering site for a new pumping station.

The Four Wheel Auto Drive Company will erect a factory at Clintonville, Wis.

The La Crosse (Wis.) Rubber Mills Company will greatly enlarge its plant.

The plant of the Empire Brush Company, Troy, N. Y., was badly damaged by fire.

The North Western Railroad will install an electric-light plant at Baraboo, Wis.

West End Furniture Company, Rockford, Ill., will build an addition to its plant.

The Daleville (Ind.) Glass Company will erect a large addition to its bottle plant.

The Millgrove Glass Company, of Millgrove, Ind., is looking for another location.

The Bangor Wood Mantel Company has constructed a new plant at Bangor, Penn.

Colgate & Co., Jersey City, N. J., will erect an addition for the manufacture of boxes.

The Kane (Penn.) Blind and Screen Company will rebuild its plant recently burned.

The J. E. Jones Shoe Company is to remove its plant from Lynn, Mass., to Middletown, N. Y.

The plant of the Joliet (Ill.) Wheel Manufacturing Company was burned. Loss, $300,000.

The Youngstown (Ohio) Carriage and Wagon Company has purchased site for a new plant.

The American-French-Belgium Glass Company, Du Bois, Penn., will construct a large new plant.

The Nagle Packing Company, Jersey City, N. J., will enlarge its plant and erect a new power house.

The Northern Ohio Traction Company, Can-

ton, Ohio, will erect a $1,250,000 power plant at Cuyahoga falls.

The Adirondack Granite Company is considering building a $50,000 polishing mill at Plattsburgh, N. Y.

The Rubber and Celluloid Harness Trimming Company, Newark, N. J., will erect a five-story addition.

The Federal Motor Truck Company, Isabella street, Detroit, Mich., is in the market for an air compressor.

The Bauer Glass Company, of Eaton, Ind., will move its plant from that place and is looking for a location.

The Lauter Piano Company, Newark, N. J., will erect a new plant.

The electric-light department, Perkasie Borough, Penn., will install a 185-kilowatt direct-current generator.

The Old Vincennes Distilling Company, at Vincennes, Ind., will spend $150,000 for improvements at the distillery.

Fire destroyed the plant of the Minn Billiard Company, 1588 Hopkins road, Milwaukee, Wis. Loss, $75,000.

The Gardner Broom Company, 80 Warren street, New York, is looking for suitable site for a new and modern plant.

The Bergner & Engle Brewing Company, Philadelphia, Penn., will build a boiler and engine house to cost $27,000.

The Bison City Table Company, Buffalo, N. Y., will erect a new plant at Scoville avenue and the Pennsylvania railroad.

P. Maddrell & Sons, Canton, Ohio, are erecting two buildings to be used for the manufacture of office and store fixtures.

Pettinos Brothers, manufacturers of foundry castings, graphite, etc., at Bethlehem, are building an extension to their plant.

The National Electric Lamp Company, Cleveland, Ohio, is erecting an addition to its plant at 4517 Hough avenue, northeast.

The Clinton Knitting Company, Clinton, N. Y., is to install a 50-horsepower engine which will double the capacity of the plant.

The Daleville Glass Company, Daleville, Ind., bottle manufacturer, is erecting a new factory building and will employ 500 people.

Clarke & Eichelberg have formed a partnership to make a line of artificial limbs and will locate at 33 Mullin street, Detroit, Mich.

The city of Newcastle, Ind., will purchase a site and install an auxiliary plant to increase the pressure of the city water service.

The Detroit (Mich.) Electric Welding Company is building a new plant in Fairview, near Detroit. Will install additional machinery.

The factory of the B. Meyer Broom Manufacturing Company, at 19 East Canal street, Cincinnati, Ohio, was burned. Loss, about $10,000.

C. W. Wilhelm has secured a permit to erect a two-story factory at 33 North Second street, Reading, Penn., for the manufacture of auto bodies.

The Fulton (N. Y.) Light, Heat and Power Company has let contract for the erection of a new steam power plant at East First and Van Buren streets.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids February 14, for one two-ton steel converter (schedule 3278).

The Eastern Michigan Edison Company will erect a power plant at Amy, Mich., for which H. W. Hall, division engineer, Rochester, N. Y., has drawn plans.

The Toledo Plate and Window Glass Company, of Toledo, has increased its capital stock from $100,000 to $300,000 in order to provide for additional facilities.

The Bar Brothers Manufacturing Company, of Marion, Ind., has been incorporated with a capital of $25,000, by Amel F., Otto B. and W. F. Bar, to manufacture paper.

The Graff Seamless Shoe Company, Attica, Ind., has been incorporated to manufacture shoes. Capital, $15,000. Incorporators, Andrew Graff, J. E. Merriman, F. S. Purnell.

The Crystal Ice Company, of Logan, Ohio, has found that its present plant is inadequate to its needs and a new plant will be started soon. New machinery will be installed.

The Paragon Plaster Company, Syracuse, N. Y., will erect an addition to its plant on West Fayette street, to be used for the manufacture of concrete blocks and other building material.

The Franklin Coated Paper Company, Franklin, Ohio, has been organized to manufacture paper by John J. Maloney, John J. Fisher, Walter Symmes, etc. Capital, $300,000.

The Fortune Post Company, of Richmond, Ind., has been incorporated with a capital of $10,000 by M. B. Kelsey, J. E. Peltz and H. B. Williams to manufacture cement posts for fences.

The Victor Lamp Company, Cincinnati, Ohio, has been organized to manufacture and sell all kinds of lamps. Incorporators, William J. Corcoran, John L. Corcoran, E. B. Kearans, etc.

The General Cement Products Company, Anderson, Ind., has been incorporated to manufacture cement products. Capital, $25,000. Incorporators, W. J. Wooley, Joseph Zeigler, C. K. Bagot.

The Centerfreze Ice Manufacturing Company, Camden, N. J., has been incorporated to manufacture ice. Capital, $500,000. Incorporators, W. L. Hurley, Daniel W. Myers, Zenas U. Dodge.

The Miller Shoe Company has arranged to establish a branch factory at Greensburg, Ind., and later will probably move its entire plant to that place. The branch factory will employ about 100 people.

The M. F. Carroll & Sons Company, Hillsboro, Ohio, has been incorporated with $25,000 capital to manufacture and sell buggies and carriages. Incorporators, W. F. Carroll, J. E. Carroll, C. P. Carroll, etc.

The Vincennes Electric Company, Vincennes, Ind., has been incorporated with a capital of $20,000, by W. T. Barnes, A. J. Heitz and C. W. Sherman, to generate electricity for heating, lighting and power purposes.

The Ithaca-Auburn Power Company has been formed at Ithaca, N. Y., for the purpose of electrifying the Auburn & Ithaca Interurban Railway. It is said the Remington power plant will be secured and enlarged.

The Had Chemical Company, of Yonkers, N. Y., has been incorporated with $100,000 capital to manufacture drug, medicinal and toilet articles. W. T. Eldridge and W. B. Woodward, of 127 Ellsworth avenue, Yonkers, are directors.

The plant of the Welchell Electric Company, at Anderson, Ind., was purchased by G. E. Rhodes, of Indianapolis. The plant will probably be moved either to Westfield, Ind., or Indianapolis. The company manufactured magnetos for automobiles.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids February 21, for steel bolts and nuts (schedule 3294), twist drills, steel letters, breast drills (schedule 3292), 6500 pounds machinery steel, medium bar steel (schedule 3290).

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids February 7, for 36 coaling trucks (schedule 3282), 14,100 pounds medium bar steel, 208,450 pounds medium steel shapes, 100,000 pounds galvanized sheet steel (schedule 3283), brass, bronze and steel tubing (schedule 3284).

SOUTHERN STATES

The Thos. J. Whaley Company, Berlin, Md., is building an addition to its sawmill.

Fire destroyed the paper mill of Harlan & Brother, at Leeds, Md. Loss, $15,000.

George A. Dillman, Huntington, W. Va., has been seeking suitable site for a furniture factory.

The Lynchburg (Va.) Traction and Light Company will install a 1500-kilowatt steam turbine generating unit.

The Kentucky Electric Company, Louisville, Ky., will shortly commence the erection of a new $1,000,000 plant.

Charlotte Steam Laundry, Charlotte, N. C., has plans for the construction of a fireproof building to cost $30,000; modern machinery will be installed.

Jacksonville Electric Company, Jacksonville, Fla., plans the construction of a power plant and piers to cost about $450,000. Details will soon be determined.

The Atlantic-Southwestern Broom Company, Baltimore, Md., has been organized to manufacture brooms, brushes, woodenware, etc. Capital, $25,000. Incorporators, Robt. C., John Hugh and Hugh A. Norman, of Baltimore, etc.

WEST OF THE MISSISSIPPI

The Rogers (Ark.) Ice and Cold Storage Company is erecting a plant.

The Gild Edge Shingle Mill, Bellingham, Wash., was damaged by fire.

The city of Pasadena, Cal., will make improvements in its sewer system.

The Alfalfa Meal plant, at Council Bluffs, Iowa, was burned. Loss, $50,000.

The city of Klamath Falls, Ore., will make improvements in its sewer system.

C. J. Hann, Middleton, Idaho, is contemplating the erection of a pickle factory.

The citizens of Deming, N. M., have voted to issue $35,000 bonds for sewer system.

The city of Brandon, Ore., is contemplating the installation of new electric lights.

The city of Yacolt, Wash., will make extensive improvements in its water system.

The Farmers Butter and Cheese Association, of Milford, Iowa, will erect a new plant.

The Olympia Power Company, Olympia, Wash., is building a power plant on the Elwha river.

Plant of the Carstens Packing Company, Tacoma, Wash., was destroyed by fire. Loss, $50,000.

The Glendora Mutual Water Company, Glendora, Cal., will install new pumping equipment.

George Saunders, San Bernardino, Cal., is contemplating extensive irrigation work in this vicinity.

The Portland Cement Company, Gold Hill, Ore., will build a large cement factory to cost $300,000.

J. L. Harpham, Eugene, Ore., has purchased the Eugene creamery and will make extensive improvements.

James Thompson, Seattle, Wash., is contemplating the erection of a barrel factory at Bellingham.

Ham & Watson, Spokane, Wash., will make extensive alterations in their boiler room and equipment.

The Tulare Canning Company has been organized at Tulare, Cal., and will build a canning factory.

The Shingle and planer mills of the Waldport Lumber Company, Waldport, Ore., were destroyed by fire.

Bismark Scholl, Ritzville, Wash., is contemplating the erection of a lumber mill at Washtucna, Wash.

The National Cold Storage and Ice Company, Portland, Ore., will build a two-story ice-plant addition.

S. M. Blumauer, Portland, Ore., is at the head of an enterprise to build a large brewing establishment.

Jay D. Crary, South Bend, Wash., has been granted a franchise to build a street-railway system in the city.

The city of Modesto, Cal., is planning for the installation of a new sewer system; estimated cost, $65,000.

The Jones-MacIntyre Candy Company, Tacoma, Wash., will erect a new boiler-room addition to its plant.

The Selby Smelting and Lead Company, San Francisco, Cal., will build a new factory to cost $26,300.

The Fremont Gas and Electric Company, at Fremont, Neb., will enlarge and improve its plant during the year.

The Pacific Coast Pottery Company, San Jose, Cal., has taken out a permit for an addition to its factory.

The Olympia Power Company, Port Townsend, Wash., will make improvements and extensions in its system.

The J. G. White Company, Northport, Wash., is contemplating the erection of a sawmill and box factory.

John King, Sunnyside, Wash., is at the head of an enterprise to erect a plant for cotton-goods manufacture.

The city of Snohomish, Wash., is having plans prepared for extensive improvements and extensions in its water system. Bonds for $110,000 will be voted.

The Santa Fe Railroad Company is planning for the erection of a large oil refinery in the Midway district, Cal.

The Redding Brewing Company, Redding, Cal., is contemplating the removal of its plant to Klamath Falls, Ore.

The Acme Manufacturing Company, Tacoma, Wash., will rebuild its woodworking factory recently destroyed by fire.

It is said the purchase of a new 3,000,000-gallon pump is being contemplated by the commissioners at Emporia, Kan.

The Midway Light and Power Company, Maricopa, Cal., will install a complete natural-gas system in this section.

The Hamm Brewing Company, of St. Paul, Minn., will erect a refrigerator and cold-storage plant at Mobridge, S. D.

The plant of the International Creosoting Construction Company, Beaumont, Tex., was destroyed by fire. Loss, $80,000.

The Panama Lumber and Mill Company, Alameda, Cal., will build a new planing mill. Modern facilities will be installed.

The Call Lemon Association, Corona, Cal., will build a large addition to its packing house. Modern facilities will be installed.

The Mount Adams Electric Railway (W. W. Swan), White Salmon, Ore., will soon commence the construction of an electric road.

The Golden Valley (Minn.) Slaughter House Company will erect a plant. James Sweeney, proprietor, Golden Valley, Minn.

The Rogue River Electric Company, Medford, Ore., is planning for the erection of a power plant of 75,000 horsepower at Prospect.

The *Pasadena Daily News*, Pasadena, Cal., is taking bids for the erection of a new printing establishment and publishing plant.

The International Lead and Pig Iron Company, Spokane, Wash., is planning for the erection of a large plant on the Pend d'Oreille river.

The Pike County Water Company, Murfreesboro, Ark., is having plans prepared for hydroelectric plant of 10,000 kilowatts capacity.

The Sun Chemical Company will establish a plant at 577 Seventh street, Des Moines, Iowa, for the manufacture of a varnish renewer.

The Twin Falls Raft River Land and Water Company, Twin Falls, Idaho, is planning for extensive improvements in its irrigation system.

Equipment will be required in the macaroni factory to be erected at Seattle, Wash., by Mr. Donofrio. R. L. Robertson, architect, Seattle.

The Hoquiam Wood and Pulp Company has been organized at Hoquiam, Wash., and will build a wood-pulp factory. F. L. Moore, manager.

The high school, at Ontario, Cal., is contemplating the erection of a new building for its woodworking department with increased facilities.

The Tucson Pressed Brick Company, Tucson, Ariz., will increase the capacity of its plant; $16,000 will be expended on new equipment.

The Whidby Island Light and Power Company has been incorporated at Port Townsend, Wash., and will build a power plant at Coupeville, Wash.

The Morgan-Stansbie Company, Eugene, Wash., operating a planing mill, has incorporated for $40,000 and will double the capacity of its plant.

The Siskiyou Electric Company, Siskiyou, Ore., has made application to the city council, at Klamath Falls, Ore., for a 50-year franchise for a power plant.

The Oakland & Bay Shore Railway Company has been incorporated at Oakland, Cal. The company will spend $2,000,000 in construction work and equipment.

The Rogue River Valley Gas Company, Los Angeles, Cal., operating at Grants Pass, Ore., is contemplating the erection of a gas plant. About $100,000 will be expended.

The National Powder Company, Dishman (near Spokane), Wash., has changed its name to the Jexite Powder Company, and will make extensive improvements in its factory.

The Sacramento Valley Power Company, San Francisco, Cal., has increased its capital stock from $800,000 to $2,000,000 and will make extensive improvements in its system.

The Northwestern Electric Company, Tacoma, Wash., has acquired a power site on the North Fork Lewis river and is said to be contemplating the erection of a power plant.

The San Dimas Orange Growers' Association, San Dimas, Cal., has let the contract for a new packing house to replace the one destroyed by fire. Modern equipment will be installed.

The Alum Rock Park Commissioners, San Jose, Cal., have recommended a bond issue of $125,000 for the improvement of this district, including a general water-supply system and a septic tank.

The General Fertilizer Company, San Bernardino, Cal., will build a large factory. The contract for the first building (the mixing plant) has been let. Modern facilities will be installed throughout.

C. L. & W. N. Lawson, Tacoma, Wash., are advertising for bids for their Nisqually power plant, including power house, waterwheels and generators, piping, etc., as well as for equipment for their Tacoma substation.

E. H. Rose, Los Angeles, Cal., has purchased the property of the Needles Light and Power Company, Needles, Cal., and will make extensive improvements and enlargements. A new power plant will be built.

The San Joaquin Light and Power Company, Fresno, Cal., operating the street-car system, at Bakersfield, Cal., is planning to expend $400,000 in improvements and extensions. New rolling stock will be purchased.

W. F. Holt, El Centro, Cal., has purchased the Coachella, Cal., ice plant and will make extensive improvements. A 10-ton unit will be added. He is also planning for an electric-light plant in the Coachella section to supply power for pumping plants.

The L. A. Railway Company and the Fairchild-Gilmore-Wilton Company, Los Angeles, Cal., have organized the Corona Rock Company. The company has purchased 62 acres of rhyolite property in the vicinity of Corona, and will install a modern plant.

The Geary Street municipal railroad, San Francisco, Cal., will soon advertise for bids through the board of public works for: Rail bonds ($500), tubular steel trolley poles ($17,000), rail fasteners ($18,000), copper wire ($8000), steel tie nuts and bolts ($3000).

The Southwestern Sugar Company, Los Angeles, Cal., a new incorporation, with $1,000,000 capital stock, has purchased a site of 80 acres, near Perris, Cal., and will erect a beet-sugar factory of 500 tons capacity; $500,000 will be expended on building and machinery.

CANADA

The Campbell Milling Company will erect a large mill at Midland, Ont.

Messrs. McKenzie & Mann will build a large power house at Winnipeg.

The town of Arnprior, Ont., will install a plant for pumping by electricity.

The Dominion Graphite Company will construct a plant at Buckingham, Que.

The Seymour Electric Power Company, of Port Hope, will make important extensions.

The Chemical Laboratories Company will equip a large new testing house in Toronto.

The Montreal Terra Cotta Company will equip a very large new plant at Pointe Claire, Quebec.

The Alberta Linseed Oil Company will erect a $500,000 refining plant at Medicine Hat, Alberta.

Vancouver, B. C., will spend $400,000 improving its waterworks system and much machinery will be required.

The New Dominion Copper Company, operating the Rawhide mines, Phœnix, B. C., has lost its machine shops through fire. The plant will be rebuilt.

MEXICO

The Torreon (Mex.) Mercantile Company will install an ice plant at Velardena, Mex.

The Guanajuato Light and Power Company, Guanajuato, Mexico, is building a power plant on the Angulo river.

The Mexican Eagle Petroleum Company, Tampico, Mexico, will build a large oil refinery. Sir W. Pearson is the head of this company.

The Mexican Northern Power Company, operating in Chihuahua (state), Mexico, is planning for the erection of a hydroelectric plant on the Conchos river.

MINING

The Tightner mine, Sierra county, Cal., will build a new mill in 1911.

The Helena Smelting Company's plant, Helena, Mont., was damaged by fire.

The Mina Grande mine, Jalisco, Mexico, is contemplating the erection of a mill.

The Arizona-Empire mines, near Parker, Ariz., will install new hoisting equipment.

The Europa mine, Chihuahua, Mexico, is contemplating extensive development work.

The Georgia Slide mine, Georgetown, Eldorado county, Cal., will install a new mill.

The Uncle Sam mine, near Kennett, Cal., is planning for extensive development work.

The El Caballo mines, in Chihuahua, Mexico, will install new machinery at its shaft.

The Utica mine, Paddy's Peak, Nelson, B. C., will install a concentrating plant in 1911.

The Hayden Hill mine, Sierra county, Cal., is rebuilding its plant which was destroyed by fire.

The Kenai Gold Company, operating in the vicinity of Seward, Alaska, will install a mill in 1911.

The Chicago Exploration Company, operating in Sonora, Mexico, will install a new smelting plant.

The London Mountain Copper Company, operating near Christmas, Ariz., will install new machinery.

The Poano Mining Company has been organized in Zacatecas, Mexico, and will build a cyanide plant.

The Square Deal Mining Company, operating the Clipper mine, Shasta county, Cal., will erect a mill.

The Bald Mountain mining district, near Porterville, Cal., will soon be in the market for new machinery.

The Osgood & Deep Gravel mines, in the Waldo district, Ore., is contemplating extensive development work.

The West Coast Mining and Development Company, operating in Sonora, Mexico, will build a smelting plant.

The Humboldt Consolidated Mining Company, Humboldt, Ariz., is planning for extensive development work.

The Santa Efigenia Mine and Milling Company, operating in Tepic state, Mexico, will install a reduction plant.

Judge Dean, manager, Lead King mine, Marble, Colo., will build a small mill on his property in the spring.

The Birchville mine, Graniteville district, Nevada county, Cal., is rebuilding its milling plant recently destroyed by fire.

The Winona Gold Mining Company, operating near Cody, Wyoming, is contemplating the erection of a smelting plant.

The Round Mountain Mining Company, operating in the vicinity of Goldfield, Nev., will enlarge the capacity of its mill.

The Live Oak Development Company, operating near Globe, Ariz., is contemplating the erection of a concentrating plant.

The Philadelphia Gold and Copper Mining Company, Jalisco, Mexico, will increase the capacity of its concentrating plant.

The Lincoln Gold Mining Company, Libby, Mont., operating at Sylvanite, is contemplating the erection of a 100-stamp mill.

The Arizona Consolidated Smelting and Mining Company, operating near Tucson, Ariz., will install a 500-ton smelting plant.

The Mother Lode Company, operating at Salmo, in the Sheep Creek district, British Columbia, will build a 50-ton concentrating plant.

The Union Dredging Company, operating near Folsom, Sacramento county, Cal., contemplates the installation of a 9-ft. bucket dredge.

The Scott Bar Hydraulic Mining Company, operating in the Scott Bar district, near Redding, Cal., is planning for extensive development work.

The Ozark Mining and Milling Company, operating the Wild Rose mine, in the Pierce City district, Idaho, will install a 200-ton concentrating plant.

The New Aurum Mining Company, Los Angeles, Cal., operating properties in the vicinity of Tuolumne, Cal., is planning for extensive development work.

The East Butte Copper Mining Company, operating the Pittsmont mines, Butte district, Mont., will install a new hoisting plant; $200,000 will be expended.

The Arados mines, Chihuahua, Mexico, will install new churn drills and build a large concentrating mill. C. R. Hoyt, Lowell, Mass., is president of these mines.

The Santa Rosa mines, operated by the Guanajuato Mining and Milling Company, Guanajuato, Mexico, will install an aërial tramway and a 100-ton cyanide plant.

The Southern Pacific mine, near Navajoa, Sonora, Mexico, has been taken over by the Mexican-American Smelting and Refining Company. The company will make extensive improvements and install new machinery.

Business Items

At the anual meeting of the directors of Joseph T. Ryerson & Son, held January 23, the following officers were elected: President, Clyde M. Carr; vice-president and treasurer, Joseph T. Ryerson; secretary, Gilbert H. Fearsall. Edward L. Ryerson was elected chairman of the board of directors.

The Joseph Dixon Crucible Company reports that during 1910 it supplied graphite and graphite lubricants to 210 different steam railroad companies and 91 automobile manufacturers. Its business with the steam railroads increased 53 per cent., while that with automobile manufacturers increased 260 per cent.

Hermann Boker & Co. have opened a New England warehouse at 125 Purchase street, Boston, Mass., where they will carry a large and complete line of all kinds of steel, wire and metals. This store is under the management of H. B. Eaton, who has been Hermann Boker & Co.'s eastern representative for the past nine years.

Forthcoming Meetings

National Metal Trades Association, annual meeting, April 14, 1911, New York City, Hotel Astor. Robert Wust, commissioner, New England building, Cleveland, Ohio.

American Foundrymen's Association, annual convention, Pittsburg, Penn., May 23 to 26, 1911. Richard Moldenke, secretary, Watchung, N. J.

American Society of Mechanical Engineers; monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. S. Clark, secretary, 141 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Philip Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

Philadelphia Foundrymen's Association; meetings first Wednesday of each month, Manufacturers Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

WANTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care, 505 Pearl Street, New York, will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper catalog free. E.G.Smith, Columbia, Pa.

Test indicators. H. A. Lowe, Cleveland, O.

Wanted—Work for turret lathes and gear cutter. Box 222, AMERICAN MACHINIST.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Wanted—Work for screw machines and gear cutter. Box 775, AMERICAN MACHINIST.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Wanted—Contract work or light weight specialties to build. Wm. A. Cather, Pottsville, Penn.

Wanted—Gisholt lathe or vertical turret lathe; also universal grinder. W. S. Ammon, 17 South Front St., Reading, Penn.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

The Brunswick Refrigerating Co., of New Brunswick, N. J., are prepared to take on one or more manufacturing propositions.

Patents. C. L. Parker, Patent Attorney, ex-examiner Patent Office, 990 G St., Washington, D. C. Write for Inventor's Handbook.

Wanted—An article to manufacture suitable for the railway, automobile or hardware trade; must be patented and exclusive. Address Box 356, AMERICAN MACHINIST.

A gentleman knowing the requirements of the Australian trade, solicits accounts for American tools and machinery; highest reference given. Box 436, AMERICAN MACHINIST.

Send broken cast iron parts for repair by oxy-acetylene welding at one-fourth cost of new ones; pay after you test them. Waterbury Welding Works, Waterbury, Conn.

General foreman invites correspondence with parties interested in building kerosene motors; have patent pending; European practice in oil motors. "O. M.," AMER. MACH.

Manufacturer of telegraph machines, adding machines, taxameters, accurate interchangeable parts, dies and special tools, invites orders for similar special manufacturing. The Universal Telegraphic Company, Successors to the Rowland Telegraphic Company, Baltimore, Md.

Tools, dies, jigs and light and medium weight machinery designed and built to order; duplicate parts, either machined or die cast. Precision Die Casting Co., Syracuse, N. Y.

Large English firm of machine tool importers having showrooms and offices in Great Britain, France, Germany, Italy, India and Japan is wanting good agencies for machine tools of all kinds. Box 189, AMER. MACH.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—First-class toolmaker in Connecticut. Box 389, AMERICAN MACHINIST.

Wanted—A designer experienced in the development of ignition apparatus for automobiles, including the design of magnetos, distributors, etc.; a pleasant and profitable position with a growing concern now well established in the trade is open for a first class man. Box 405, AMERICAN MACHINIST.

Wanted—First class draftsman, one experienced on jig and fixture work; Connecticut. Box 388, AMERICAN MACHINIST.

ILLINOIS

Machinery supply salesman; man who is now calling on mechanical trade to take a small tool specialty as side line; used in every shop; good commission; sample weighs seven ounces. Box 421, AMER. MACHINIST.

Growing Chicago company making small electrical machinery, desires to communicate with man who can take complete charge of manufacturing end; must be a finished mechanic, with practical ideas and executive ability; man who qualifies will be given opportunity to become financially interested; give full particulars, age, salary, experience, etc., in confidence. Box 390, AMER. MACH.

INDIANA

Wanted — Engineering salesman; young man, technical graduate preferred, to sell a well known line of special machinery; state preparation, experience and salary expected. Address "B. C.," AMERICAN MACHINIST.

IOWA

Wanted—Draftsman, experienced in designing dies for heavy machine work; prefer one acquainted with hydraulic machinery. Box 357, AMERICAN MACHINIST.

Competent mechanic to take charge of and financial interest in gasolene engine factory and develop with the business; fine opportunity for the right man; give experience. New Hampton Mfg. Co., New Hampton, Iowa.

MASSACHUSETTS

Wanted—Traveling salesman (machinery or hardware), to sell cast bronze name plates on commission as a side line. Murdock-Reed Co., 127 Federal St., Boston, Mass.

Wanted—First-class machine designer with experience on small automatic machinery; also checker for mechanical drawing room; state experience and wages expected. Box 420, AMERICAN MACHINIST.

Wanted—Capable and energetic man to take charge of mechanical drawing room of large factory manufacturing small parts; must have held a similar position and show evidence of ability to produce results. Box 419, AMERICAN MACHINIST.

Wanted—An experienced mechanical draftsman, preferably with a technical education, or a number of years' practical shop experience, by a large manufacturing concern in Massachusetts; state age, experience and salary expected by addressing "Chief Draftsman," Box 383, AMERICAN MACHINIST.

MICHIGAN

Wanted—At Jackson, Mich., draftsman, experienced on axle, transmission and general gear work; state full particulars in first letter. Box 361, AMERICAN MACHINIST.

MINNESOTA

Wanted—Cream separator, bowl balancers; good position; answer immediately. Box 375, AMERICAN MACHINIST.

NEW YORK

Machinists—Lathe and vise hands on magnetos; state experience and wages. "W. H. C.," Care AMERICAN MACHINIST.

Grinders Wanted—First class men on Norton crankshaft grinders; also on internal and plain grinders; steady employment for good men. F.I.A.T., Poughkeepsie, N. Y.

Wanted—Experienced draftsman, familiar with rolling mill machinery and furnaces; state past experience and salary wanted. Address Lock Box 202, Massena, N. Y.

Machine tool salesman, with mechanical training; such with theoretical and practical knowledge of gear cutting machinery preferred; state salary, experience, former occupation and territory in which best acquainted. Box 386, AMERICAN MACHINIST.

Wanted—Chief engineer for large company building excavating and hoisting machinery; must be technical graduate competent to take entire charge of engineering department, systematizing the work and directing the designing of machinery; position permanent; only high grade man need apply; state fully in first letter age, education, experience and salary; all replies treated confidential. Box 424, AMERICAN MACHINIST.

OHIO

Wanted—First class machinists, toolmakers, die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood and metal patternmakers, brass polishers, buffers, finishers, millwrights, hammermen and blacksmiths, who wish to increase their opportunities, to register with the free Employment Department of the National Metal Trades Association, New England Building, Cleveland, Ohio.

Wanted—On account of increasing business company operating six automatic screw machines (Acme and Cleveland) is in need of general manager for that department; applicant must have good education and be capable of taking entire charge of all parts of the work from ordering material to shipping finished product; best of references required and would prefer man who could make a small investment in the business, but that is not essential. Box 418, AMER. MACHINIST.

PENNSYLVANIA

Wanted—Energetic young salesman for machinery business; state age, experience and salary. Otto Gas Engine Works, 33d and Walnut Sts., Philadelphia.

Foreman machinist for a growing plant in eastern Pennsylvania; must be able to handle men to advantage and produce results in a line of special machinery and gears; to the right man a splendid opportunity is offered. Box 426, AMERICAN MACHINIST.

Several draftsmen wanted; applications solicited from men with either ordnance, mechanical-electrical, or mechanical structural experience; state fully, age, experience, education and salary expected. Box 429, AM. M.

A leading high-speed engine builder is in need of an experienced superintendent and designing engineer; must be familiar with the best modern shop practice and have had previous experience in steam engine design; salary not so much of a consideration as ability; do not wish to correspond with any one not receiving a good salary now. Box 430, AMERICAN MACHINIST.

The Monotype School is maintained to train young men to meet the constant demand for operators of our type casting and composing machine; these operators do so well that we receive more applications for places than can be filled; these qualifications carry most weight: Common sense, automatic machinery experience, printing office experience, type foundry experience. Full particulars will be furnished to inquirers who furnish the same information about themselves, and mention this paper. Lanston Monotype Machine Co., Philadelphia.

VERMONT

Wanted—First class mechanical engineer and draftsman with sufficient experience and ability to design and lay out machines which will be outlined by the management; good opening for right party; give full experience, wages expected, etc. Box 417, AMER. MACH.

WEST VIRGINIA

Wanted—Experienced die setter to take charge stamping department of can factory; state experience, salary and present employment. Address "Die Setter," AM. MACHINIST.

Wanted—Man with considerable mechanical experience to superintend large plant manufacturing principally tin cans; capable of successfully handling three to four hundred hands; must have experience and executive ability; reference. "Cans," AMER. MACH.

SITUATIONS WANTED

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Superintendent or works manager with wide experience on tools, dies and general manufacturing; systematic organizer and executive; equal to large proposition; will consider change. Box 408, AMERICAN MACHINIST.

ILLINOIS

A reliable designer with experience on machine tools, stamping presses, dies, jigs and fixtures. Box 435, AMERICAN MACHINIST.

Position with future in manufacturing concern; nine years' shop, apprentice, inspector, foreman; three years' drafting, special tool construction; am 28, married; executive ability; references. Box 423, AMER. MACH.

INDIANA

Foreman, practical and technical, age 32, handle milling, drilling, lathe, planer departments, or tool room, design jigs, tools, fixtures, desires change. Box 441, AM. MACH.

Uptodate patternmaker foreman wishes to change; now in charge of 12 men and large concern; 20 years' experience; eight years foreman; write for reference or interview. Box 427, AMERICAN MACHINIST.

MASSACHUSETTS

Mechanical and civil engineer, with 17 years' shop, office and field experience, desires responsible position; heavy construction work preferred; high class man. Box 332, AM. M.

MICHIGAN

Open for engagement April 1; mechanical engineer, experienced in the design and manufacture of steam, power and centrifugal pumps. Box 373, AMERICAN MACHINIST.

MINNESOTA

Superintendent of small shop by American; wide experience, shop work, chief draftsman, and in charge of outside construction; energetic, reliable. Box 439, AMER. MACHINIST.

NEW JERSEY

Position as special machine demonstrating salesman by thorough, educated mechanic. Box 428, AMERICAN MACHINIST.

Superintendent or foreman of wood pattern maker in all classes, heavy or light marine or stationary with years' experience; best of reference. Box 433, AMER. MACH.

Position as superintendent or works manager; entire charge, a hustler with a record as an earning power, who has never failed to make good; A-1 references; look me up. Address Box 422, AMERICAN MACHINIST.

NEW YORK

Uptodate machine shop foreman desires change; wide experience on tools, jigs and general manufacture, good executive, first class references. Box 434, AMER. MACHINIST.

Foreman, designer, tool and gage work, 14 years' experience, cylindrical and thread gages, interchangeable manufacturing, desires responsible position. Box 416, AMER. MACH.

Young, practical toolmaker and machinist, with two years' road experience as salesman here and abroad, open for engagement; good references. Box 431, AMERICAN MACHINIST.

German, 37, machinist and toolmaker, 19 years' experience on tools, dies, automatic machinery, wants steady position; New York or vicinity; best of references. Box 432, AMERICAN MACHINIST.

Commercial engineer, thirty-five years old, well connected at present, is looking for more responsible position as manager, or in charge of sales or production, where field will widen from personal effort. Box 338, AM. MACH.

Superintendent, master mechanic or chief engineer, practical and technical training, manufacturing, construction, foundry, hydraulic, electric, marine, railroad and stationary engineering, wishes position. Box 409, AMERICAN MACHINIST.

A-1 mechanic, uptodate in modern methods; 22 years' shop experience, 10 years in executive position, wishes position as tool room or general machine shop foreman; good references; location New York, Connecticut or Rhode Island. Box 387, AMER. MACHINIST.

OHIO

Competent designer and draftsman desires change; age 30; shop experience; western States preferred. Box 379, AMER. MACHINIST.

Wanted—To change position; man 28, now employed as a cost and production systematizer; nine years' experience; can systematize any shop. Box 440, AMER. MACHINIST.

Works superintendent; expert on methods and small tool design, machine tools or any interchangeable product; have shown 60 per cent. increase in production from 166 machine tools in six months; American; age 42; West of Pittsburg preferred. Box 399, AM. M.

Position as works manager or superintendent; 14 years' experience in executive positions; a hustler having made good handling 2000 employees; ten years with present company; good reasons for changing; can earn $600 year; age 35. Box 396, AMER. MACH.

PENNSYLVANIA

Mechanical engineer, experienced on type setting and casting machines, electric apparatus and special tools, desires change. Box 438, AMERICAN MACHINIST.

Machine shop foreman, uptodate in modern shop methods, ten years' experience as foreman and rate setter, age 38, now employed, desires change. Box 415, AMER. MACHINIST.

Experienced mechanic, manager, systematizer, economist and a worker desires change; salary $5000. Box 437, AMER. MACHINIST.

WISCONSIN

Mechanical draftsman, German, age 28, graduate of a German University, one year practical experience as machinist, three years draftsman in America, experienced in paper machinery, desires change Box 425, AM. MA.

FOR SALE

An opportunity to start a machine shop; we offer one of our departments for sale, the one used to establish our business; it is small and profitable work, but as we are devoting ourselves to heavier work, we offer to sell for $2000, all the drawings, patterns, and stock of finished and partly finished parts and rough material (inventories over $3000), circulars, electrotypes, special machinery and fixtures, and an established trade. Address Sipp Machine Company, Paterson, N. J.

For Sale in Florida—Machine shop and fixtures, at a great sacrifice, to satisfy a mortgage, a 40x60-foot, two-story machine shop, equipped with power, machinery, tools and fixtures, and the good will of a well established business, also five acres of land, with two-story dwelling house, all located at the junction of the S. A. L. R. R. & F. M. branch of the A. C. L. railroads, with switch running to the shop door, at Apopka, Orange county, Fla., 169 miles south of Jacksonville, and 13 miles west of Orlando, Fla. Five thousand dollars cash will buy this entire property now. For further particulars address C. A. Hege, Winston-Salem, N. C.

Talks With Our Readers

By The Sales Manager

Sir Henry Bessemer was the inventor of the steel converter.

By his process the price of steel was reduced to $50 a ton, where it had been five times as much, and England's production raised from fifty thousand tons yearly to over a million and a half.

Sir Henry was rightfully the father of the steel age and to his genius as an inventor must be attributed a tremendous step forward in the world's progress.

But to Sir Henry's ability as a promoter—a salesman and advertiser—must be attributed more than half of the ultimate success of his invention.

He, like nearly every other inventor and every manufacturer of something new and unusual, ran against that element that balks progress at every step—"human inertia," the inability of people to grasp and live fully up to their opportunities.

* * *

An advertisement or a salesman calls your attention to some new device which, after years of trial and experiment, has been marketed.

Its excuse for existence is that it will save time or money or labor for its user.

What is your attitude toward that advertisement or salesman?

A negative one, isn't it? The first thing that comes into your mind or mouth is "NO!" spelled in capitals, printed in italics and emphasized.

We all get the wrong viewpoint, a twist in our mental make-up that makes us think that the advertisement is an attempt to put across something "touchin' on and appertainin' to" a lemon.

And, so, advertising must be persistently aggressive and continuous to make us do the things which are good for us to do.

We cannot buy all of the machinery or equipment offered us but that is a poor reason for refusing to investigate the merits of any of it.

Bessemer had to first convert iron ore into steel and then convert skeptics into believers.

Bell fought opposition left, right and center to get his telephone financed.

Cyrus Field laid the Atlantic cable amid the jeers and hoots of all nations.

The astute Napoleon "turned down" Robert Fulton's steam-propelled vessel—and lost a wonderful advantage to fight England on her own territory.

* * *

The mission of advertising in this paper is to spread information quickly and cheaply to the most men in the machine-making field in the least time—

To make you see that here or there is a piece of machinery or equipment that will enable you to get better results at less cost per result.

We see to it that the crook stays where he belongs—outside these columns.

So that those who do get in have the pass-word, the high sign and the salute.

It is "Be Square."

* * *

It is one thing to read advertising matter and another to benefit by what you read.

What does it avail a man to know that there is a result-getting device on the market which might be all that is said for it and do all that is claimed, unless he investigates?

* * *

Only reliable products can be continuously advertised.